


# Armed Forces College of Medicine

## AFCM




# The Long Ascending Tracts

:By

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# INTENDED LEARNING OBJECTIVES (ILO)

**By the end of this lecture the student will be able to:**

**1- Define the four long ascending tracts carrying the different sensations.**

**2- Describe the three order neurons of each of them.**

**3- Predict the effects of lesion of each tract.**

# Lecture Plan



1. **Part 1 (10 min): Introduction to sensations and sensory pathways.**
2. **Part 2 (20 min):The spinothalamic tracts.**
3. **Part 3 (15 min): The dorsal column tracts.**
4. **Part 4 (5 min): Summary.**

# The White Matter

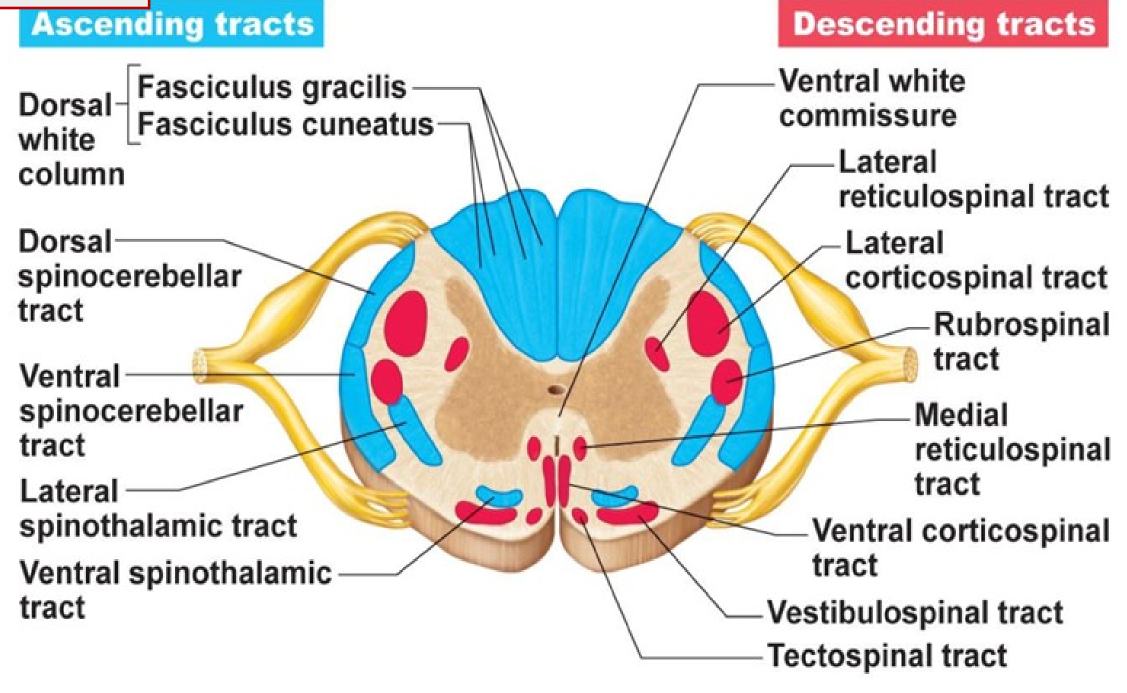


## Ascending Tracts

### Sensory Pathways

## Descending

### Motor Pathways



# The Ascending Tracts

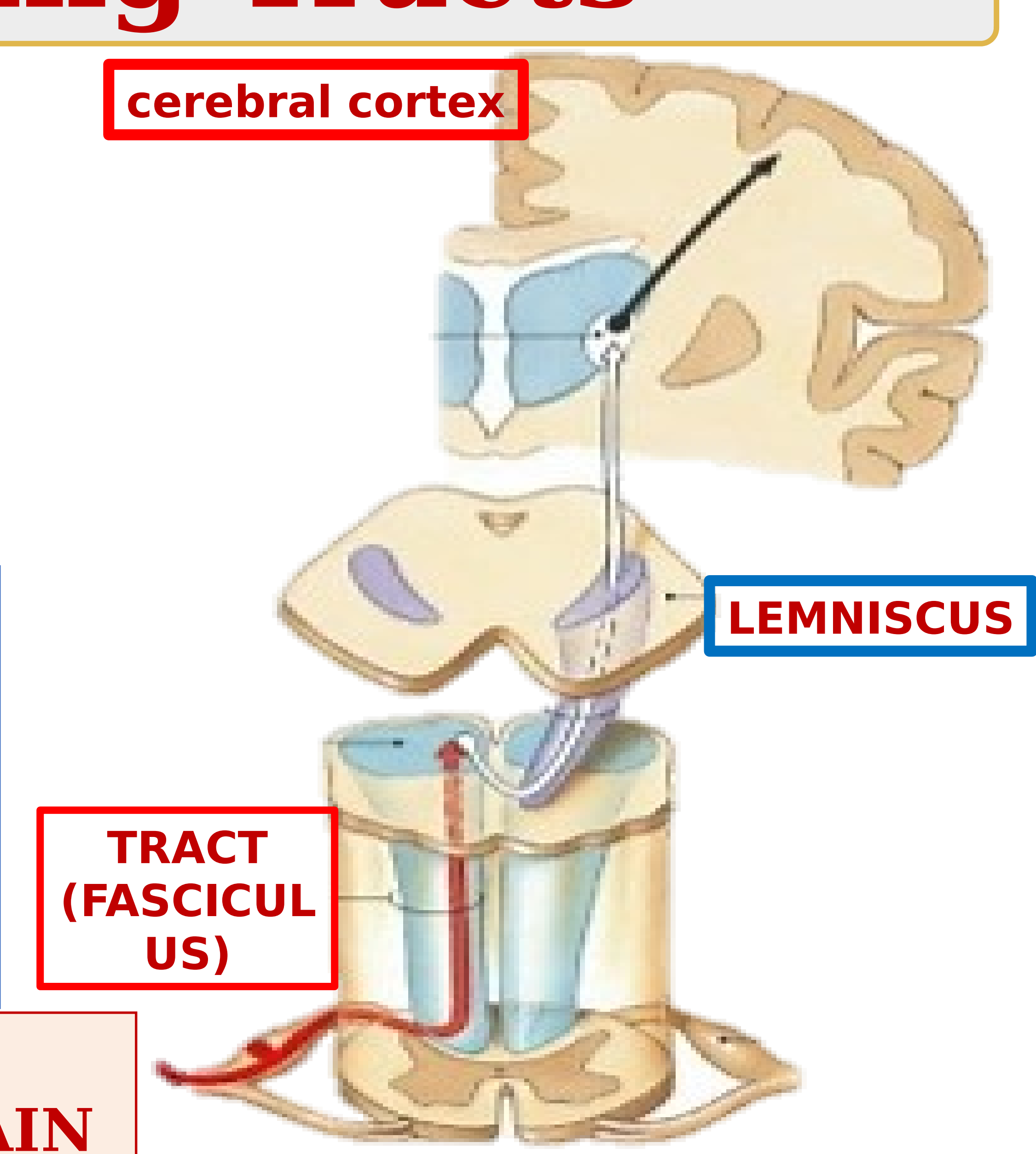
➢ **ASCENDING SENSORY PATHWAY :** Simplest form
- Start at **sensory nerve ending**
- Ends at **cerebral cortex.**
- Involve **3 successive** neurons
- Having the **same function.**

➢ **TRACT (FASCICULUS)**

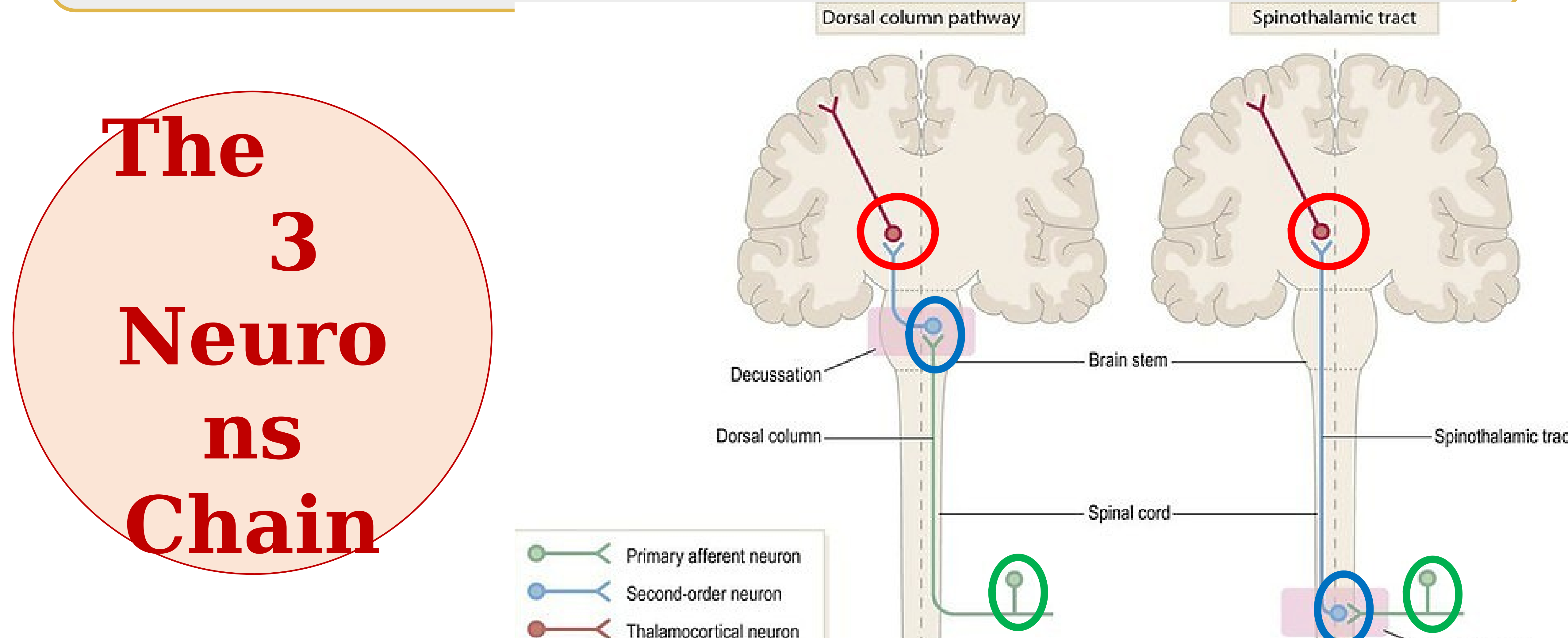
**A bundle of nerve fibers within the CNS having**
- Same origin.
- Same termination.
- Same function.

➢ **LEMNISCUS**

Collection of ascending fibers in the **BRAIN STEM**



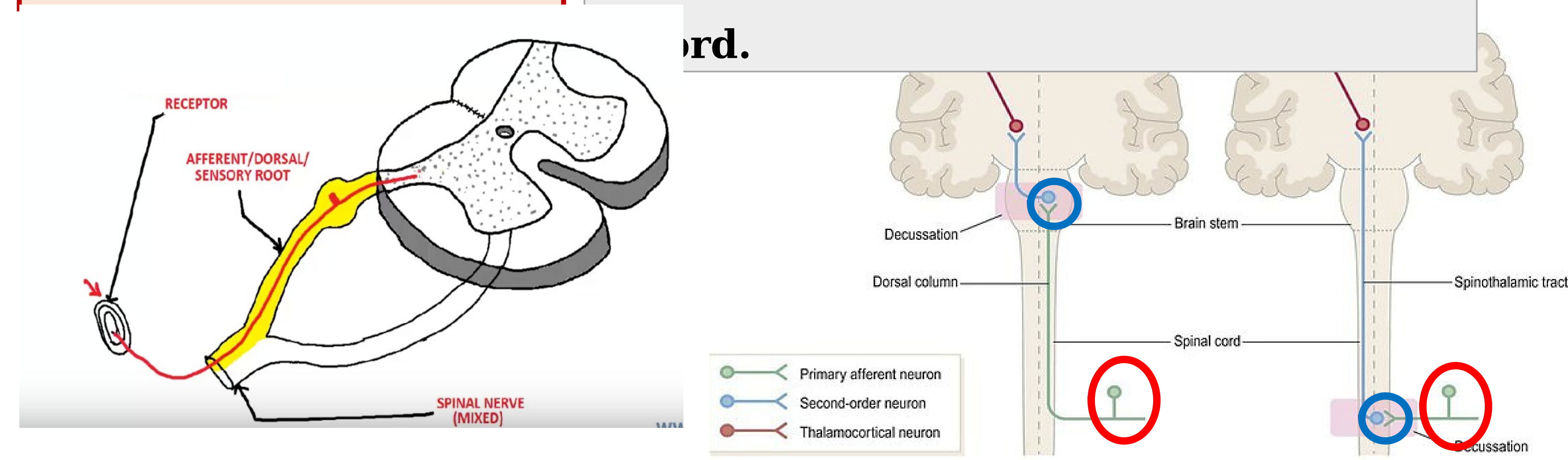
# In the sensory pathways, sensations are carried from receptors to cerebral cortex by 3 neurons:



# Organization of Sensory Pathways

## First – Order Neuron

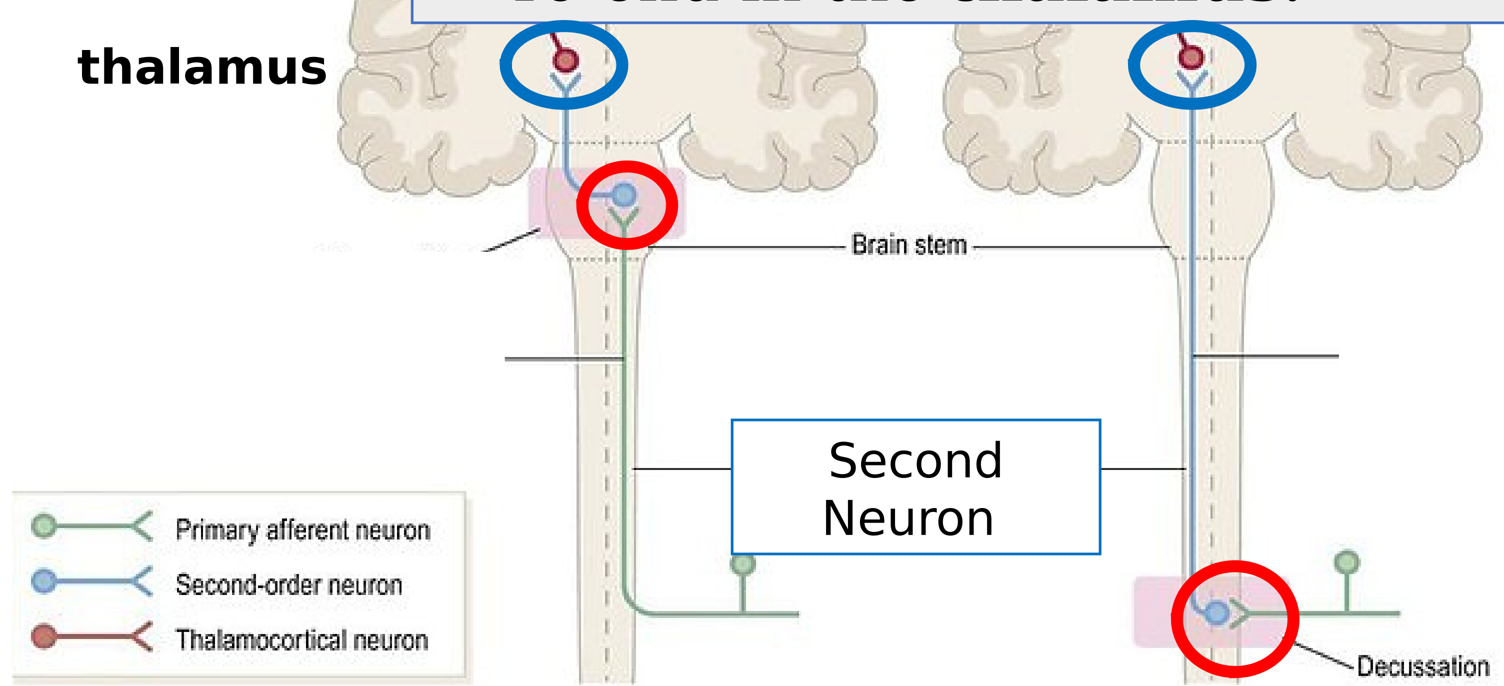
- Cell of the **Dorsal Root Ganglion.**
- Carries sensation by its **peripheral process**.
- Its **central processes** to the spinal
ord.



# Organization of Sensory Pathways

## Second-Order Neuron

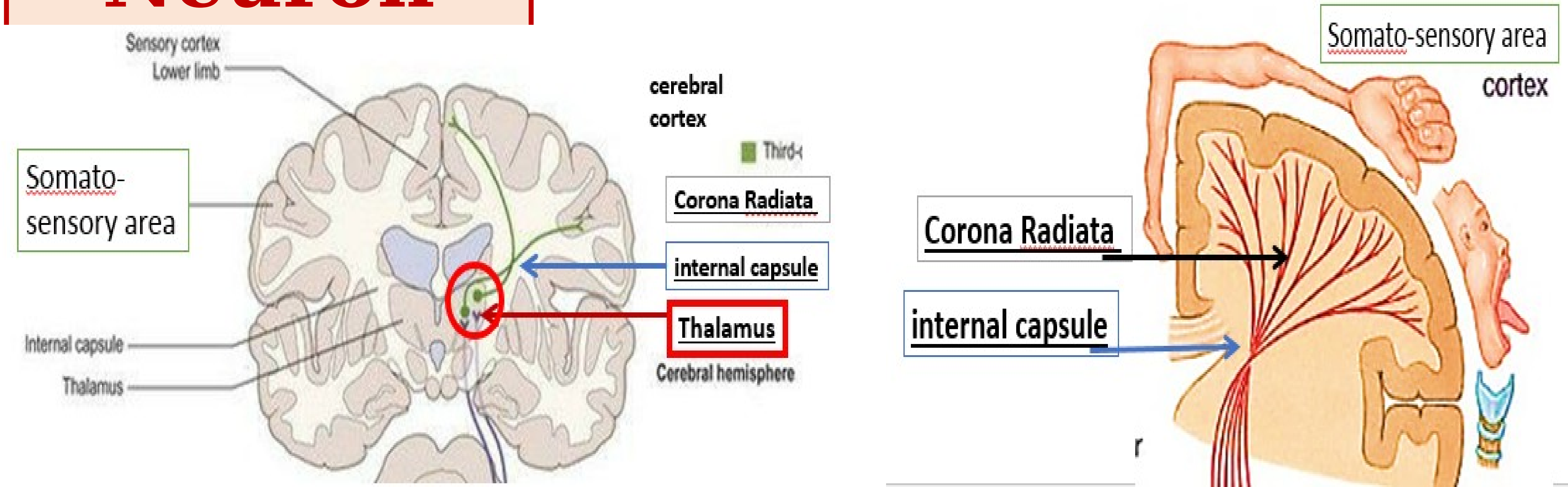
- Cell in **spinal cord** or **medulla oblongata**
- Axon always **decussates** to the opposite side
- Ascends in the **brainstem** as **Lemniscus.**
- To end in the **thalamus.**



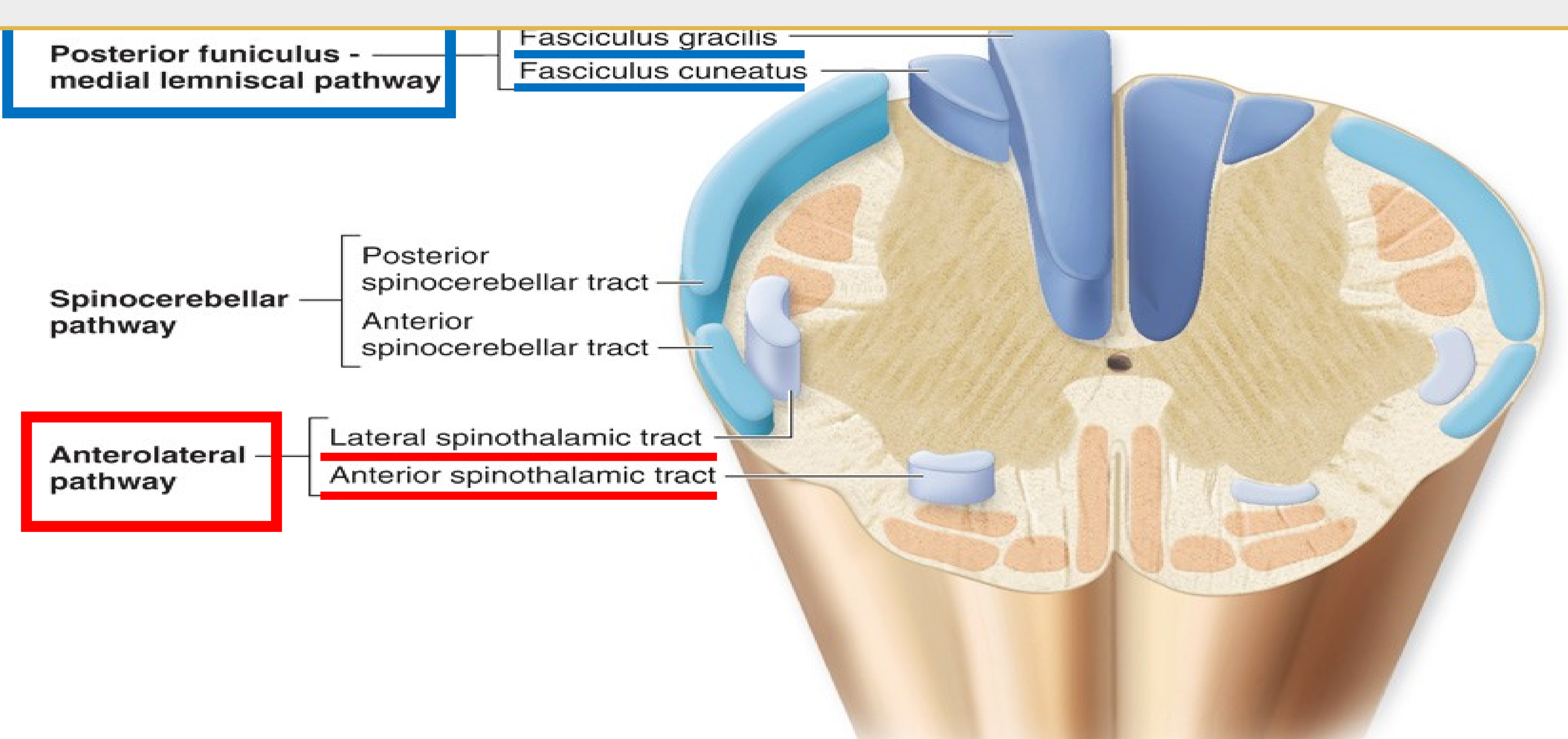
# Organization of Sensory Pathways

# Third-order Neuron

- Cells in the **Thalamus (VPLN).**
- Axon ascends upward.
- Pass through **internal capsule**
- Through **corona radiata**
- Reach **sensory area** of cerebral cortex.



# The 4 Long Ascending Tracts



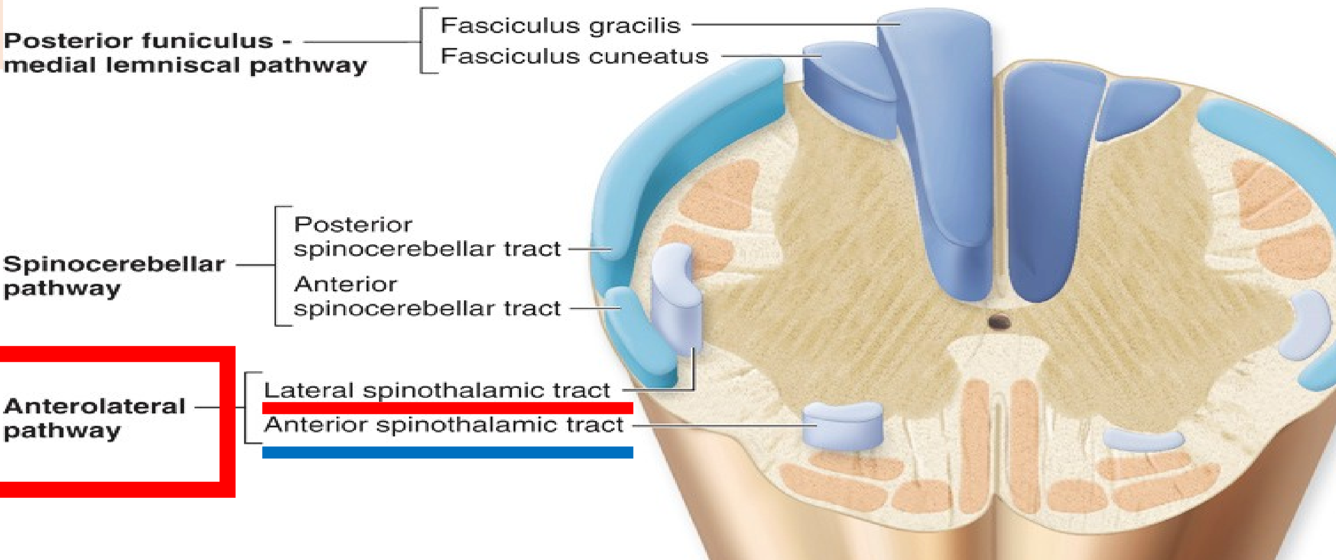
# The Spinothalamic Tracts

## Lateral Spinothalamic Tract

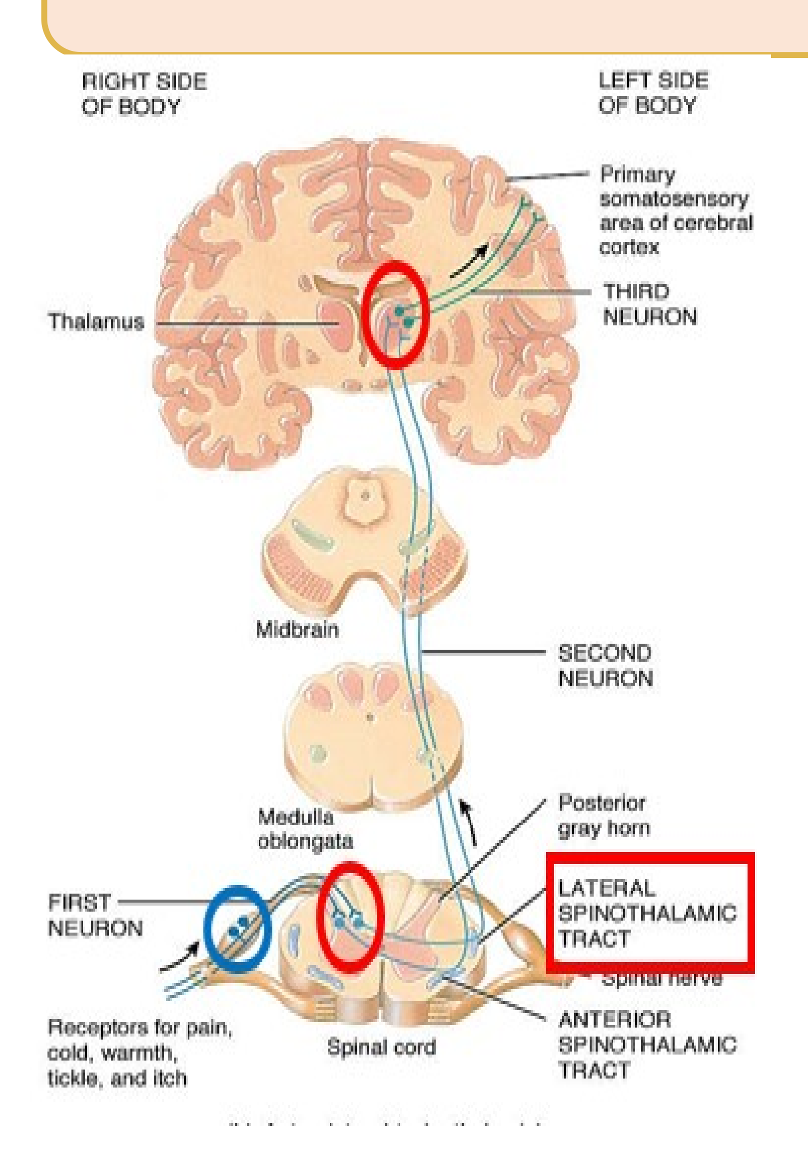
**Pain & Temp**

## Anterior Spinothalamic Tract

**Crude touch & Pressure**

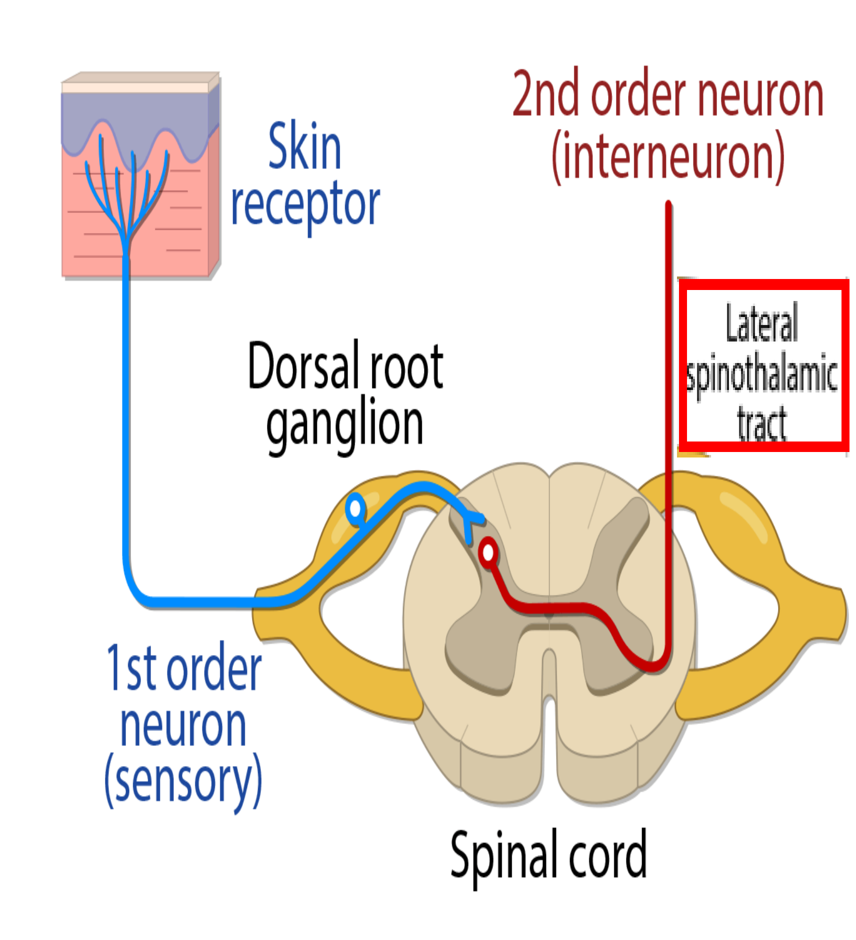


# 1- The Lateral Spinothalamic Tract




➢ **Function:**

It is the **2nd order neuron** of **Pain & Temperature** from the **opposite side** of the body to the thalamus.



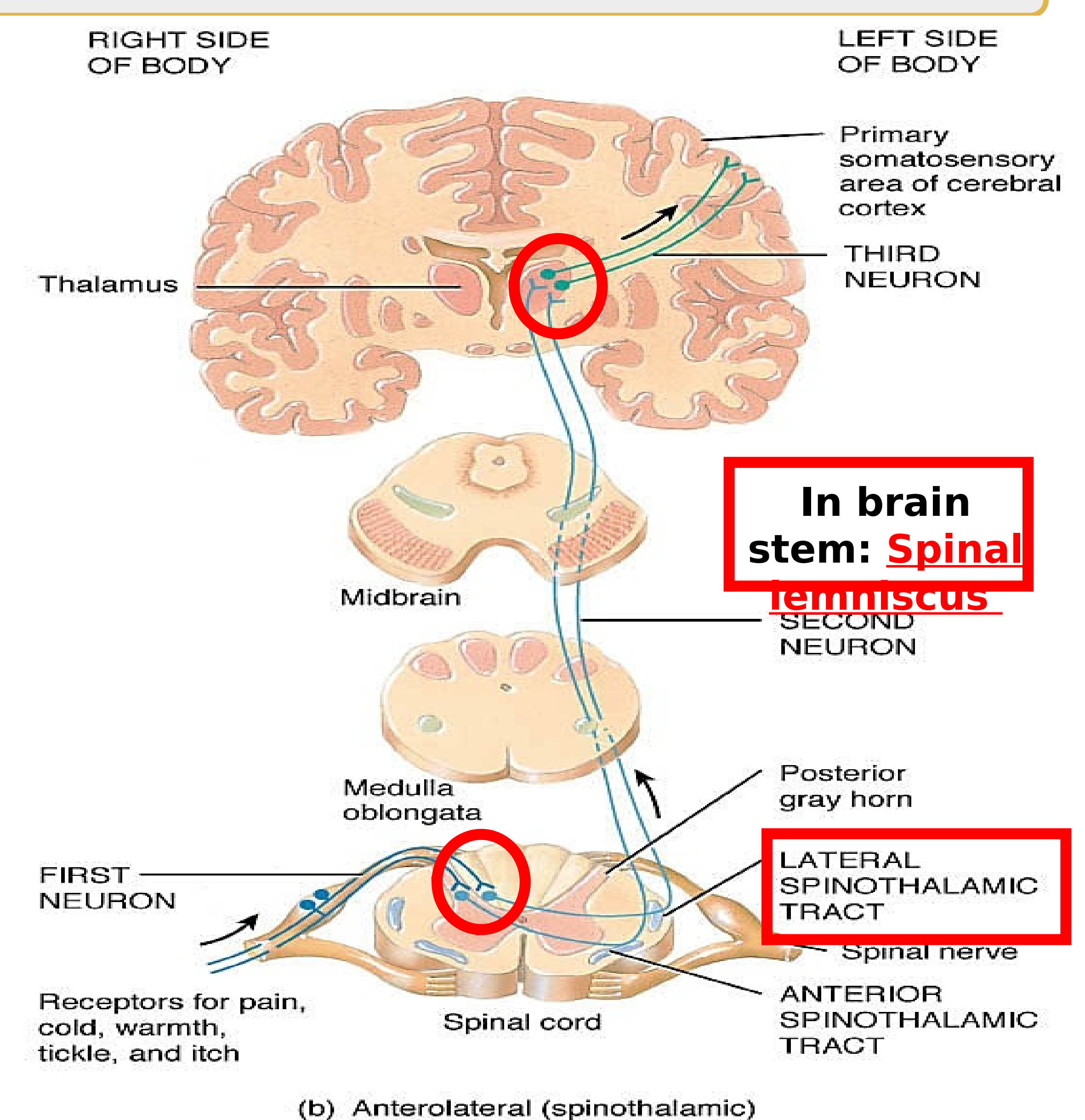
# The Lateral Spinothalamic Tract

## ➢ Begins:

- From neurons of **Laminae I & IV-VIII.**
- Their axons **decussate** in the **ventral white commissure**.

## ➢ Position in spinal cord:

Ascends in the **Lateral white column**.

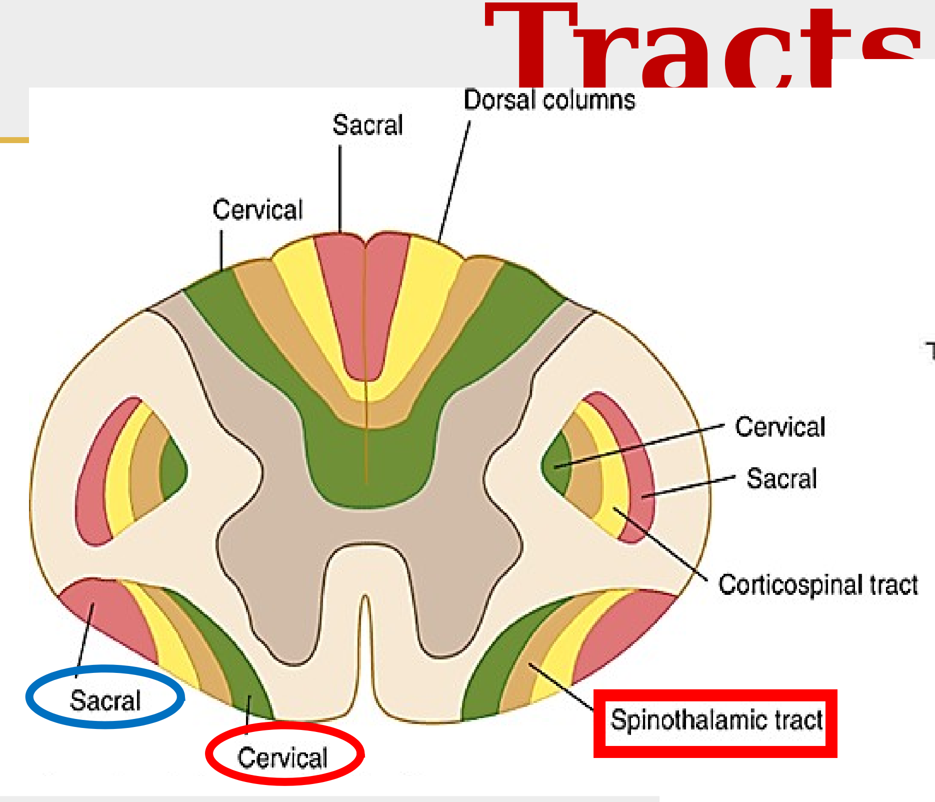


(b) Anterolateral (spinothalamic) pathways

# The Lateral Spinothalamic Tracts

- **Laminatio n:**

**Cervical** fibers are most **medially** and




- **Termination:**

The tract ascends in the brain stem as the **Spinal lemniscus** to reach the **VPLN** of thalamus.

RIGHT SIDE OF BODY

LEFT SIDE OF BODY

Primary somatosensory area of cerebral cortex

Thalamus

THIRD NEURON

**In brain stem: Spinal lemniscus**

Midbrain

SECOND NEURON

Medulla oblongata

Posterior gray horn

FIRST NEURON

LATERAL SPINOTHALAMIC TRACT

Spinal nerve

Receptors for pain, cold, warmth, tickle, and itch

Spinal cord

ANTERIOR SPINOTHALAMIC TRACT

(b) Anterolateral (spinothalamic) pathways

# Pathway for Pain and Temperature

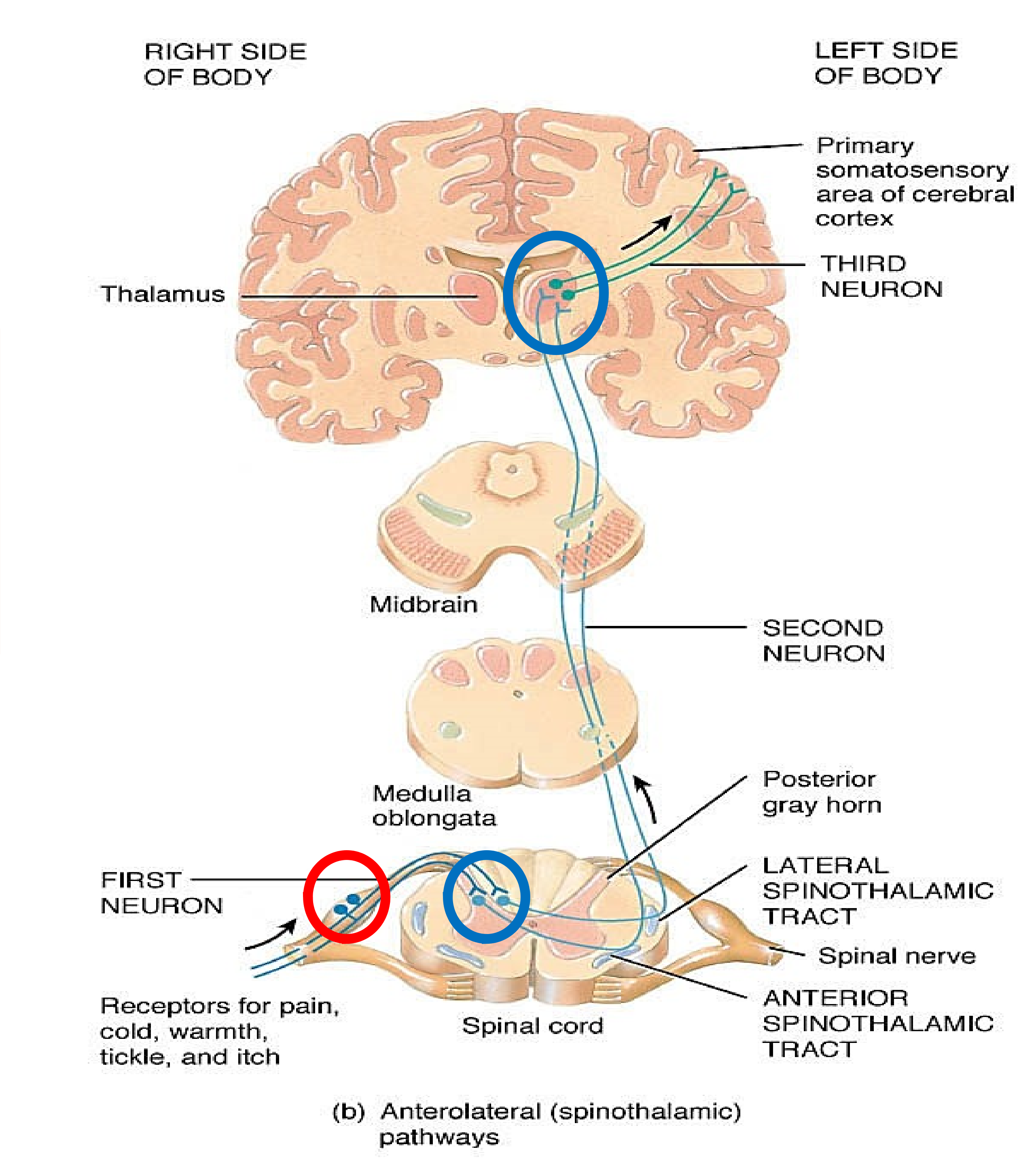
➢ **First Order Neuron:**

**Dorsal root ganglion cells**

**(Pseudounipolar)**

- **Their peripheral processes carry pain & temperature sensations from the receptors (free nerve endings in skin).**

- **The central processes end on neurons in laminae I & IV-VIII of the grey matter of the spinal**



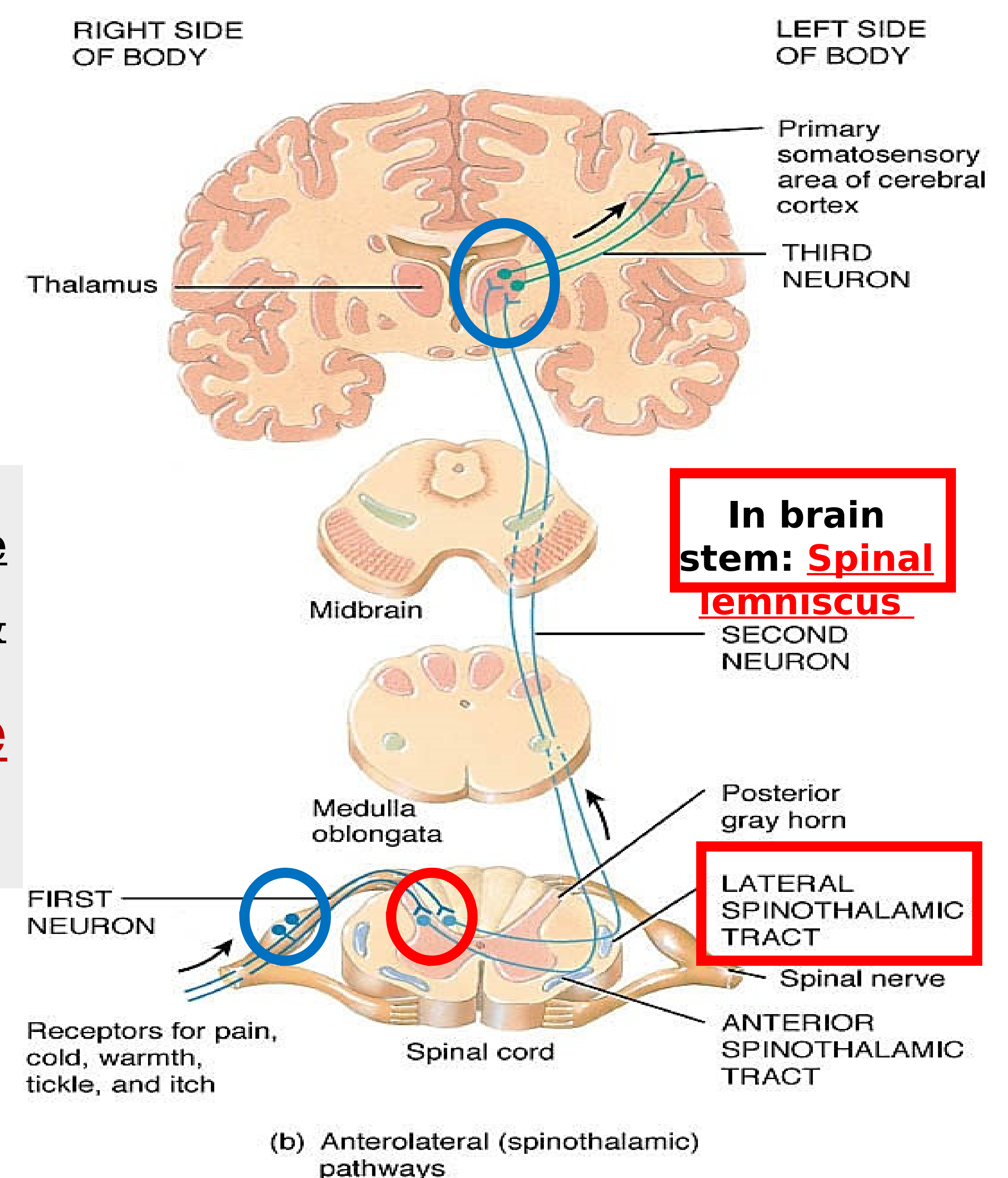

(b) Anterolateral (spinothalamic) pathways

# Pathway for Pain and Temperature

## ➢ Second Order Neuron:

Neurons in **laminae I & IV-VIII** of grey matter of spinal cord.

- **Axons of these neurons cross to the opposite side in the ventral commissure & ascend in the lateral white column as the**
- **The tract ascends in the brain stem as the spinal lemniscus. It reaches the thalamus where it ends on VPLN of thalamus.**



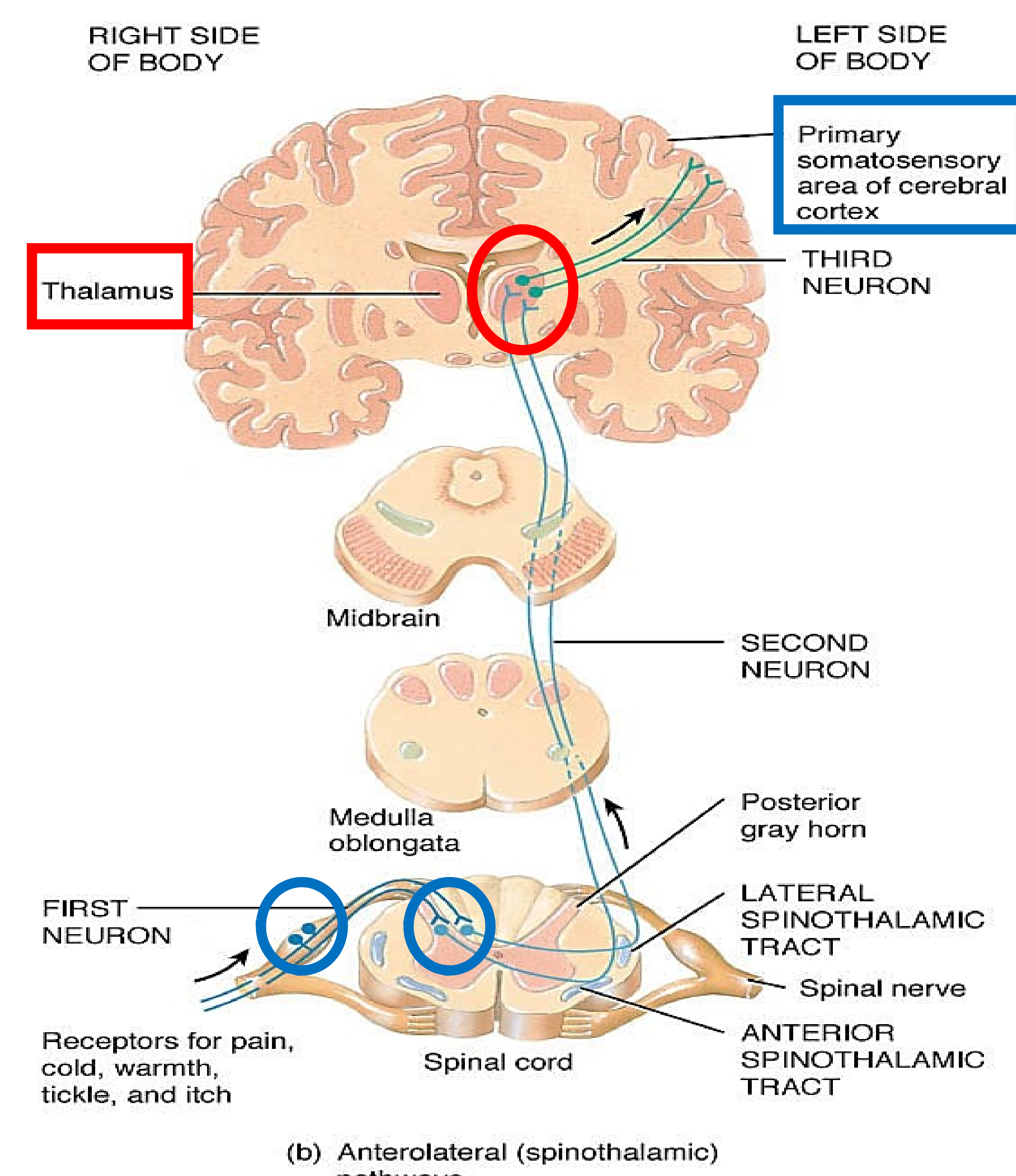
(b) Anterolateral (spinothalamic) pathways

# Pathway for Pain and Temperature

➢ **Third Order Neuron:**

**Ventral posterolateral nucleus (VPLN) of Thalamus.**

➢ **Axons of VPLN of thalamus pass in posterior limb of internal capsule, then through corona radiata to reach sensory area of cerebral cortex.**

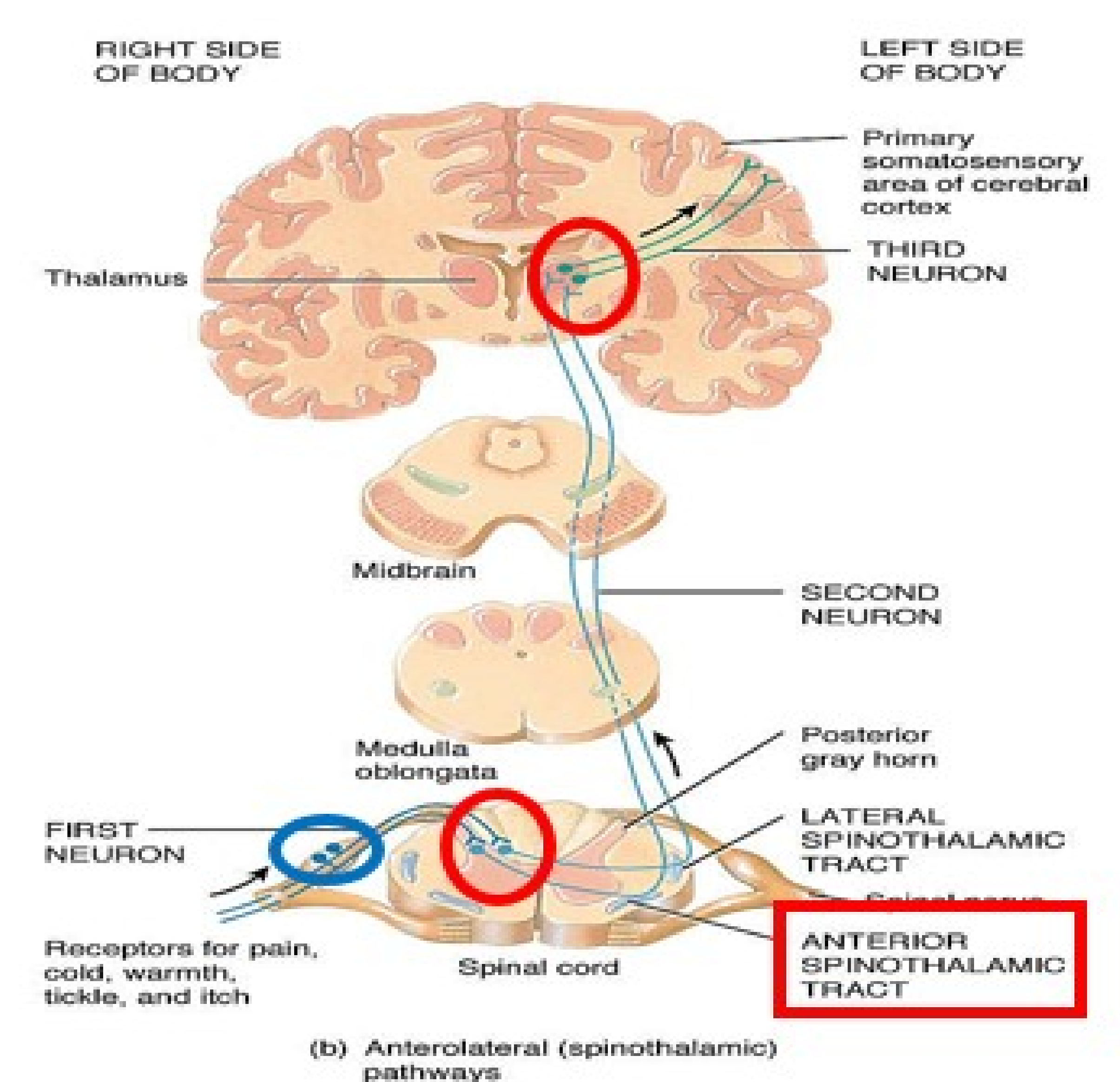


(b) Anterolateral (spinothalamic) pathways

# 2- The Anterior Spinothalamic Tract

## Function:

It is the **2nd order neuron** of **Crude touch and Pressure** from the opposite side of the body to the thalamus.



(b) Anterolateral (spinothalamic) pathways

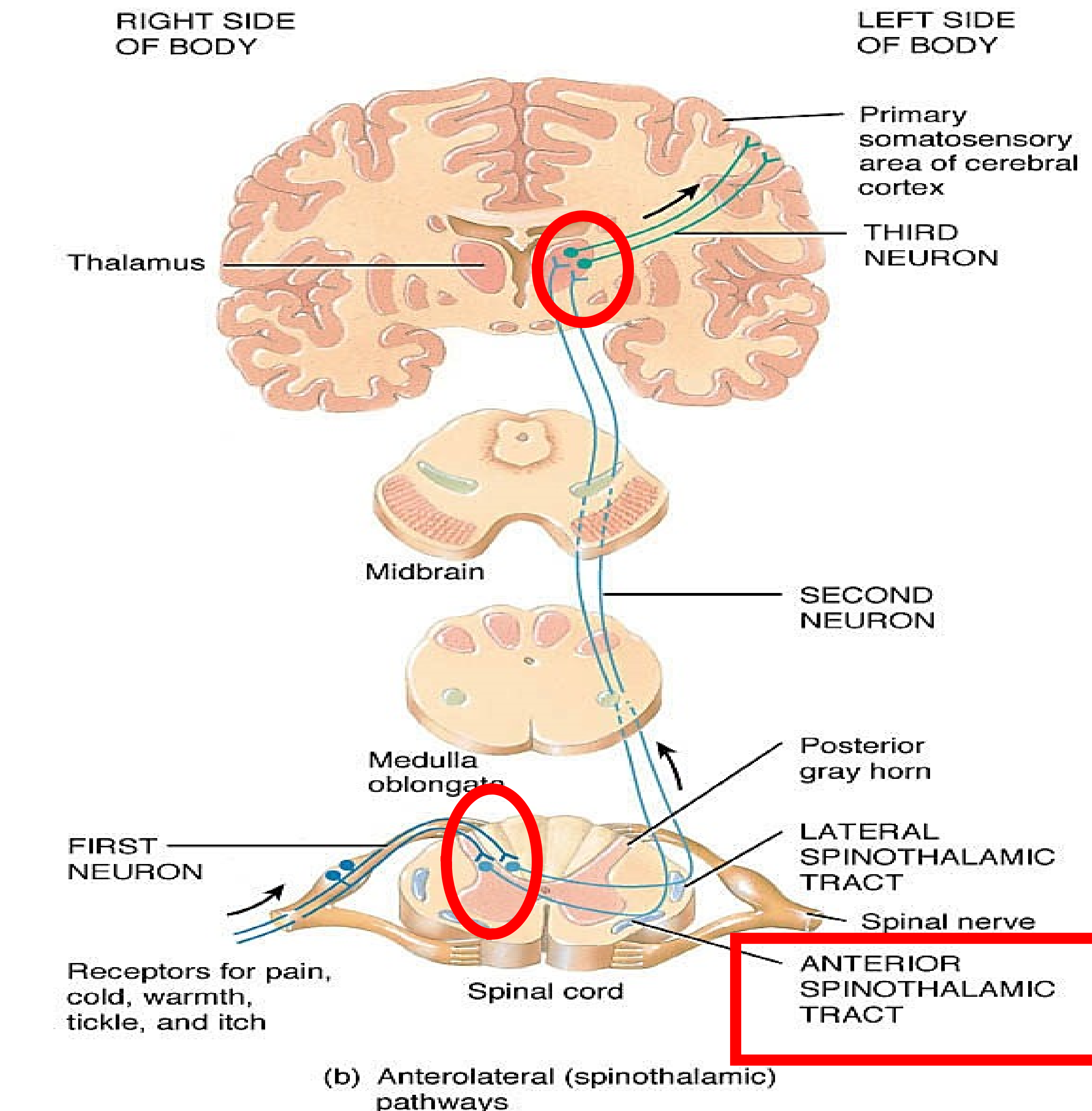
# The Anterior Spinothalamic Tract

➢ **Begins:**

- **From neurons of laminae IV-VII.**
- **Their axons decussate in the ventral white commissure.**

➢ **Position in spinal cord:**

**Ascends in the Anterior white column.**

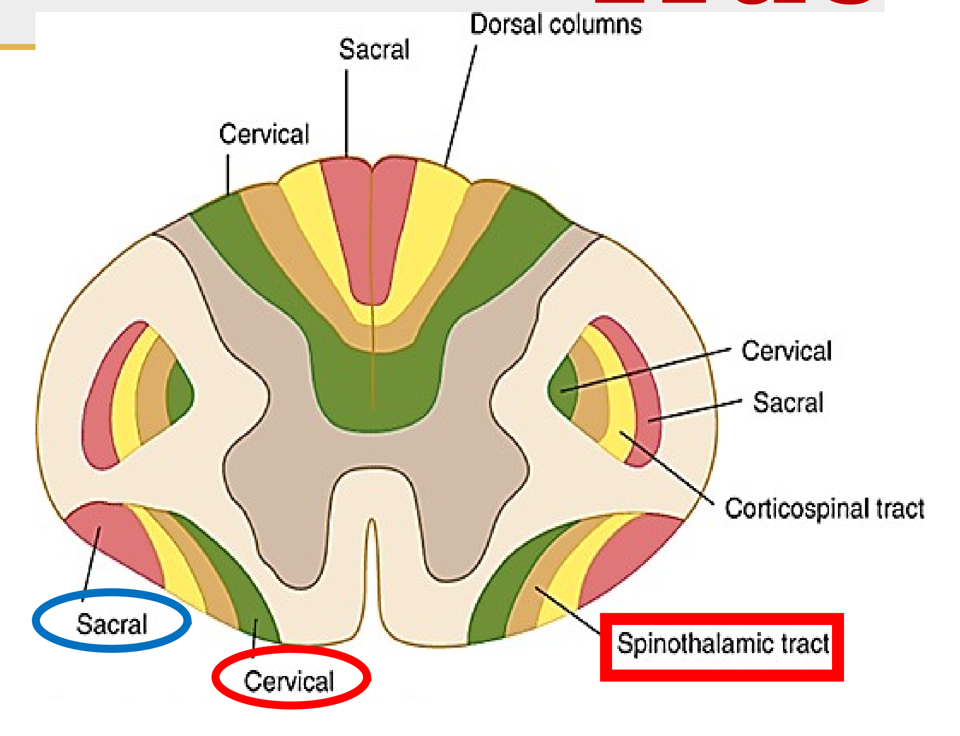


(b) Anterolateral (spinothalamic) pathways

# The Anterior Spinothalamic Tract

- **Lamination:**

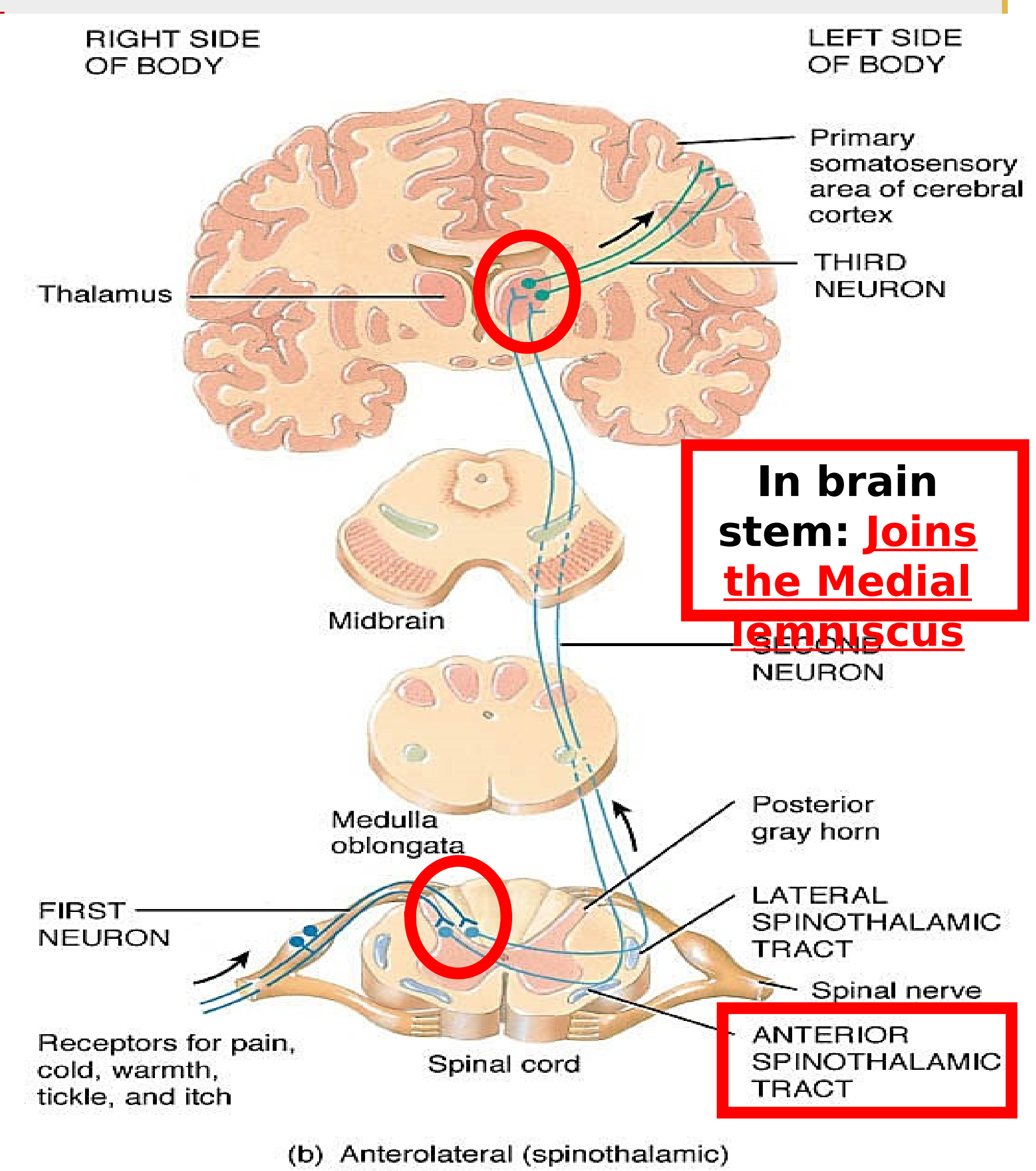
**Cervical** fibers are most **medially** and






- **Termination:**

**The tract ascends in the brain stem joining the Medial Lemniscus to reach**



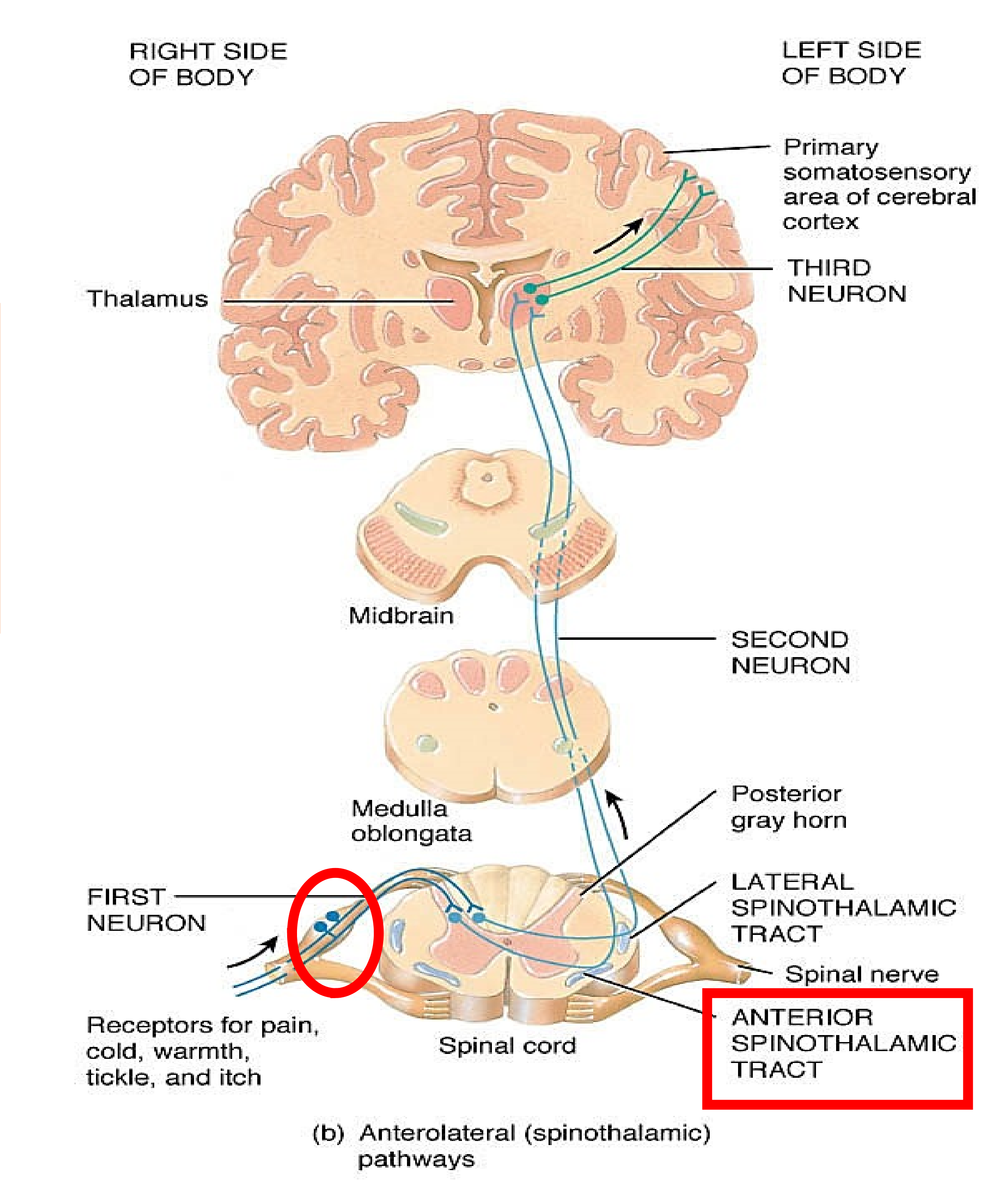

**In brain stem: Joins the Medial lemniscus**

# Pathway for Crude Touch and Pressure

## ➢ First Order Neuron:

**Dorsal Root Ganglion cells (Pseudounipolar).**

- ➢ Peripheral processes of these cells carry crude touch & pressure from the **receptors.**
- ➢ Their central processes enter the spinal cord via the dorsal root to end on neurons in **Laminae IV – VII** of the grey matter of spinal cord.



(b) Anterolateral (spinothalamic) pathways

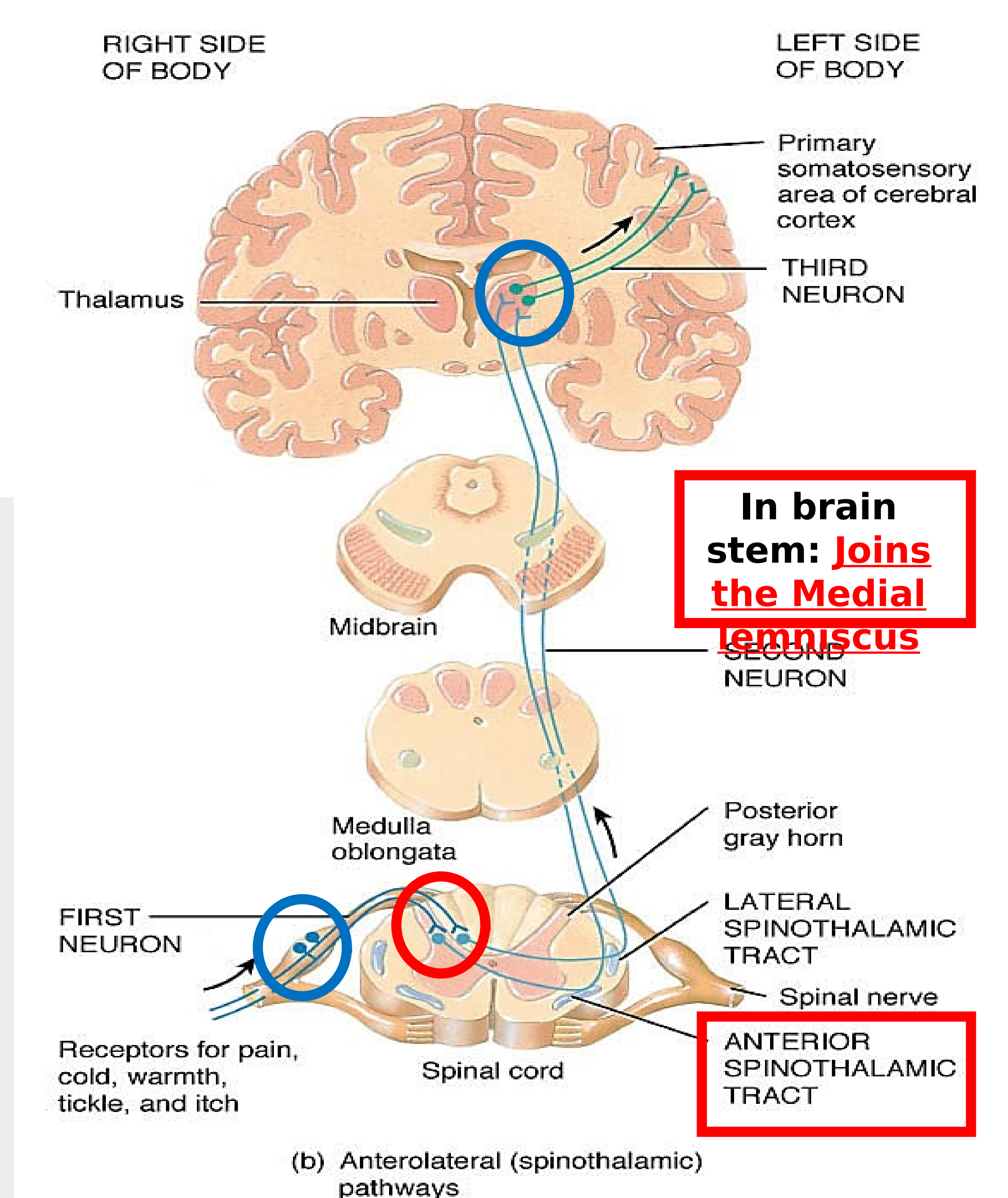
# Pathway for Crude Touch and Pressure

## ➢ <u>Second Order Neuron:</u>

**Neurons in laminae IV - VII.**

- Their axons cross in the **<u>ventral white commissure</u>** to reach the **<u>opposite</u>** **<u>ventral white column</u>** & ascend as **<u>The Ventral Spinothalamic tract.</u>**

- The ventral spinothalamic tract **<u>ascends in the spinal cord & brain stem</u>** where **<u>it joins the Medial Lemniscus</u>** &



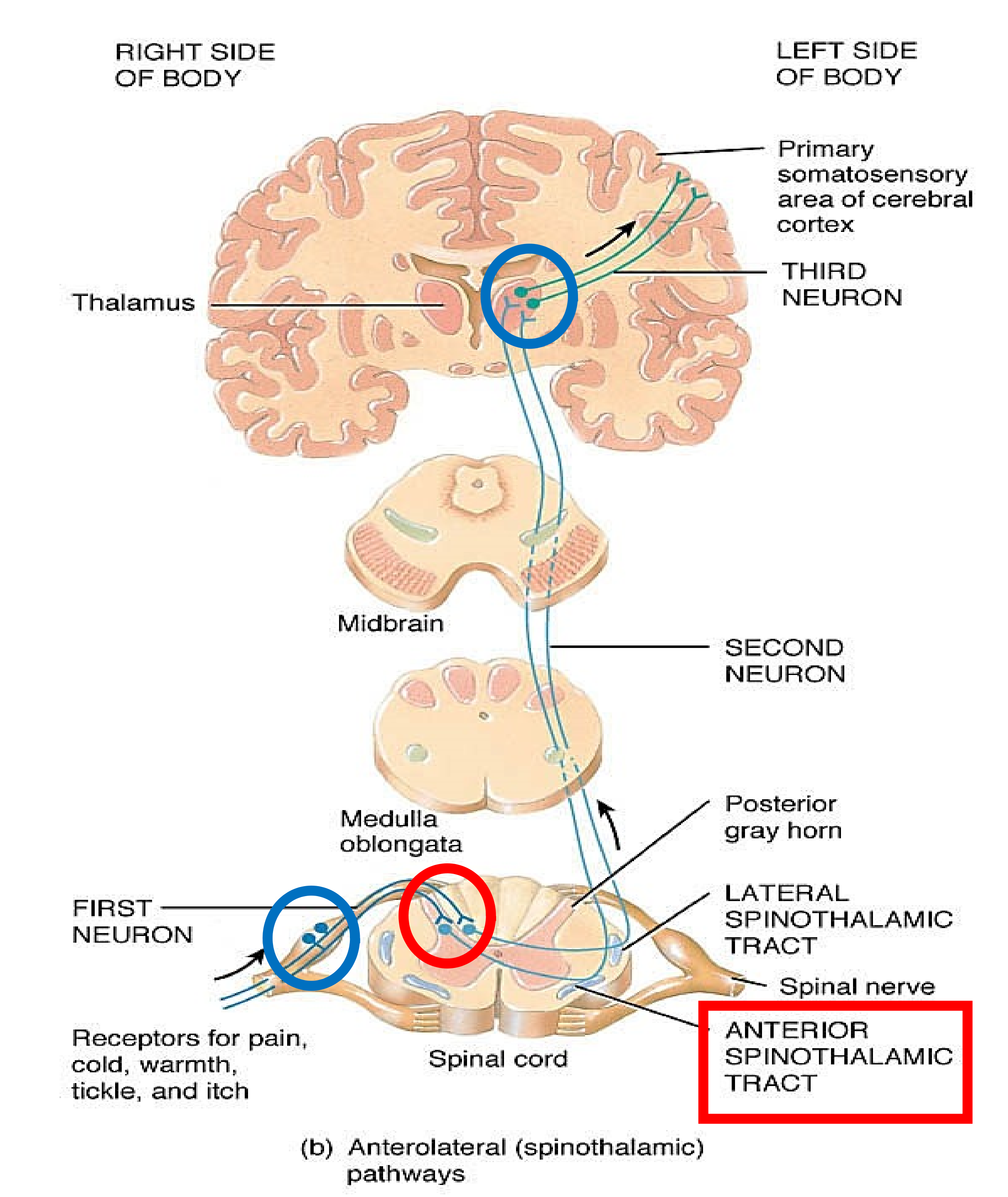

(b) Anterolateral (spinothalamic) pathways

# Pathway for Crude Touch and Pressure

➢ **Third Order Neuron:**

**VPLN of Thalamus**

➢ **Axons of VPLN of thalamus pass in posterior limb of internal capsule then through the corona radiata to reach the sensory area of the cerebral**



(b) Anterolateral (spinothalamic) pathways

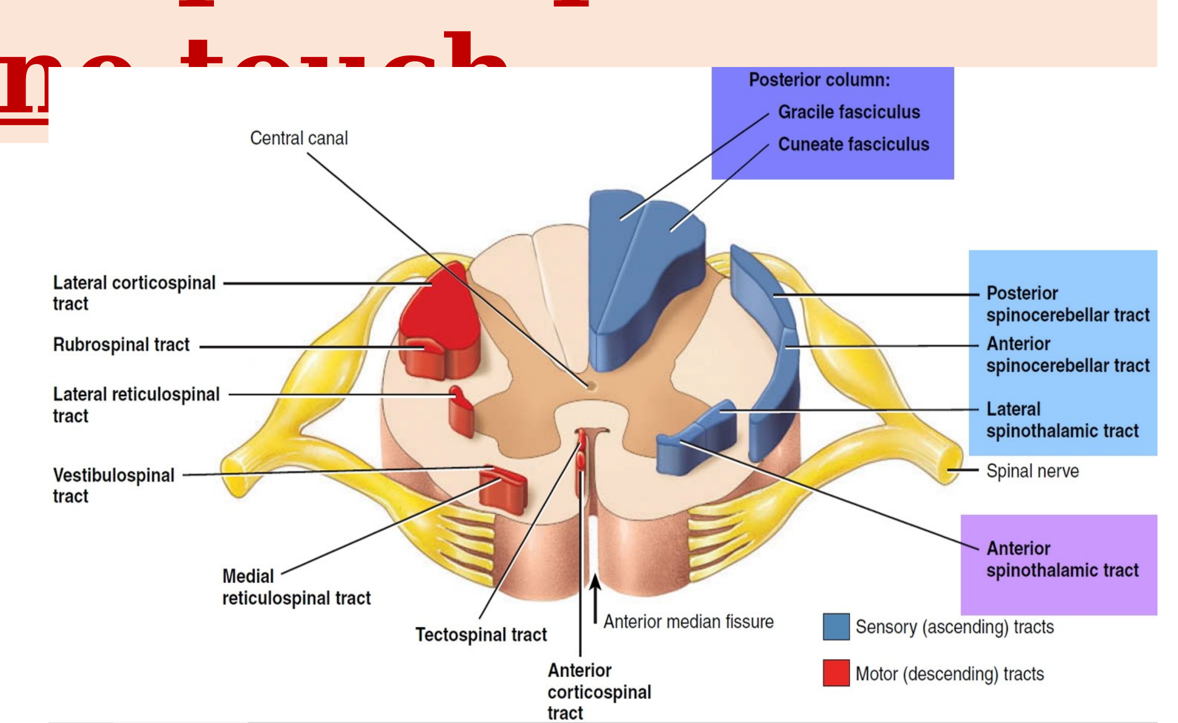
# The Dorsal Column Tracts

## Gracile Tract

## Cuneate Tract

## Conscious Proprioception & Fine touch

| Proprioception (deep sensations) | Fine touch (complex touch) |
|---|---|
| 1. Sense of position. | 1. Tactile discrimination. |
| 2. Sense of movement. | 2. Tactile localization. |
| 3. Sense of vibration. | 3. Stereognosis. |



# 3- Gracile and Cuneate Tracts

➢ **Function:**

**Carries Proprioception (deep sensations) and Fine Touch**

- The tract represent the **1st Order Neuron** in the pathway.
- Carries sensation from the **same side** of the body = **Ipsilateral**

RIGHT SIDE OF BODY
LEFT SIDE OF BODY
Primary somatosensory area of cerebral cortex
THIRD NEURON
Thalamus
Medial lemniscus
Midbrain
SECOND NEURON
Nuclei of medulla
FIRST NEURON
Medulla oblongata
POSTERIOR COLUMN
Receptors for fine touch, proprioception, and vibration
Spinal nerve
Spinal cord

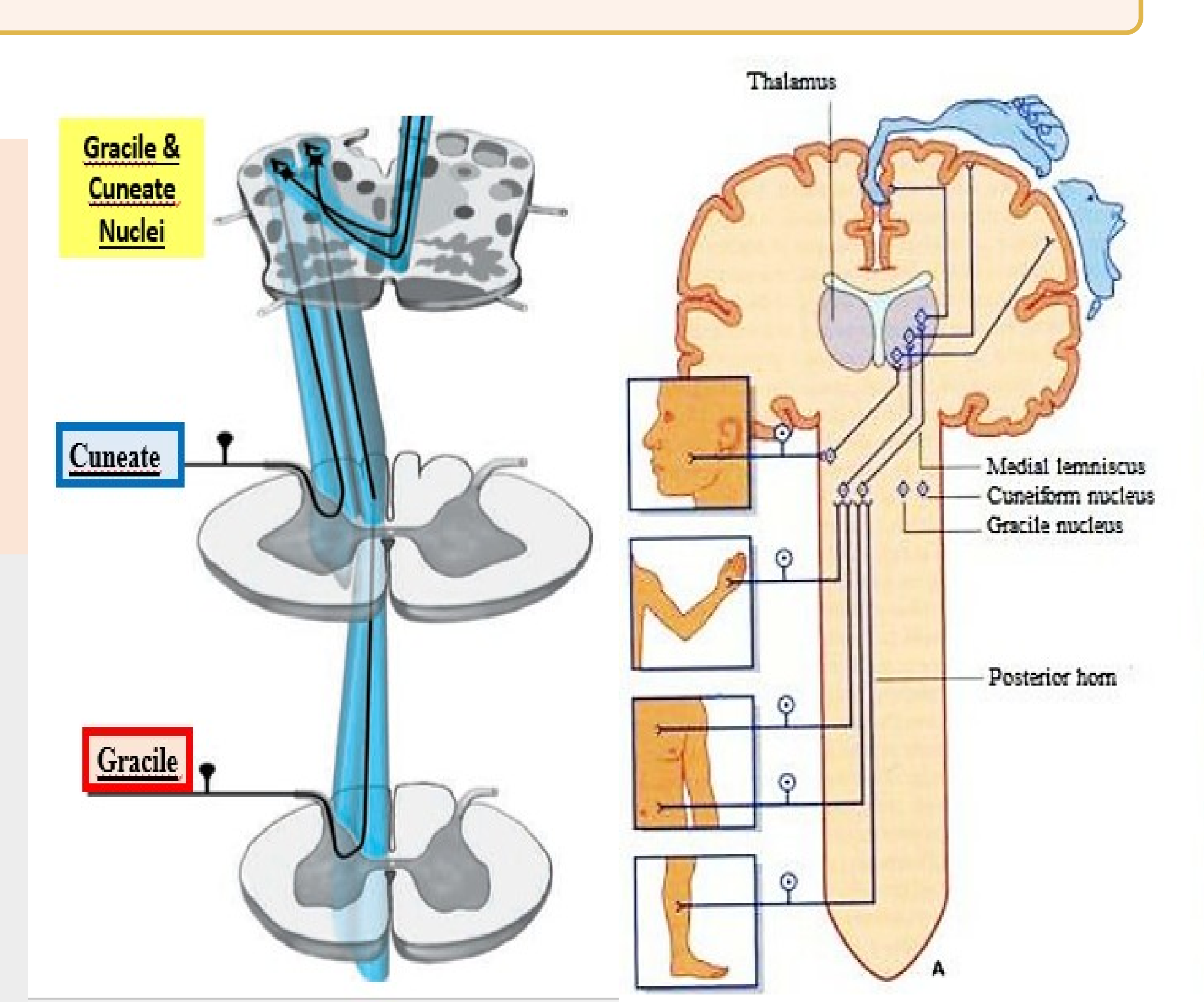
# Gracile and Cuneate Tracts

➢ **Cuneate tract:**

- From the **upper part** of body.
- **(Above T6)**

➢ **Gracile tract:**

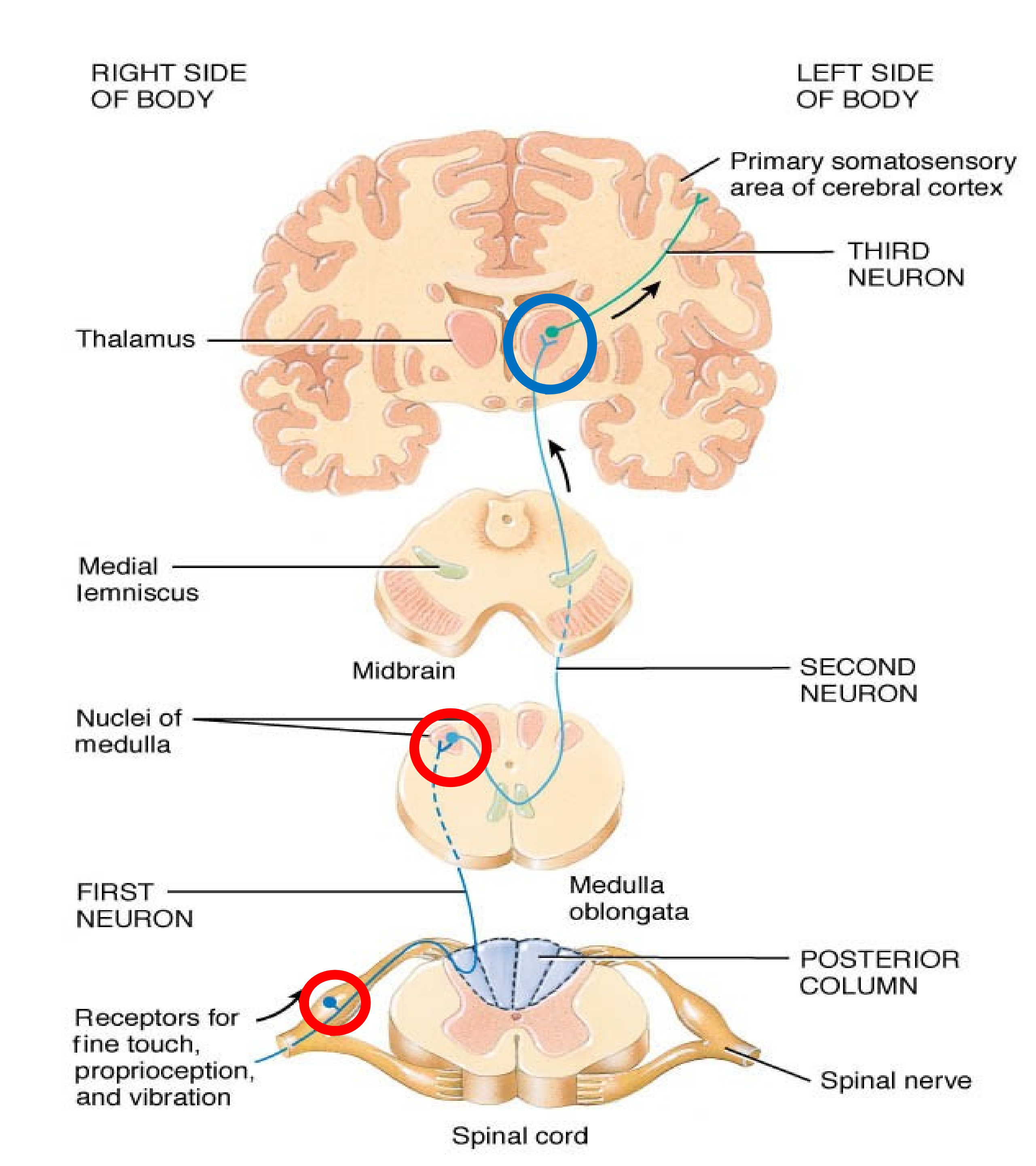
- From the **lower part** of body.
- **(Below T6).**



# Gracile and Cuneate Tracts

➢ **Beginning:**

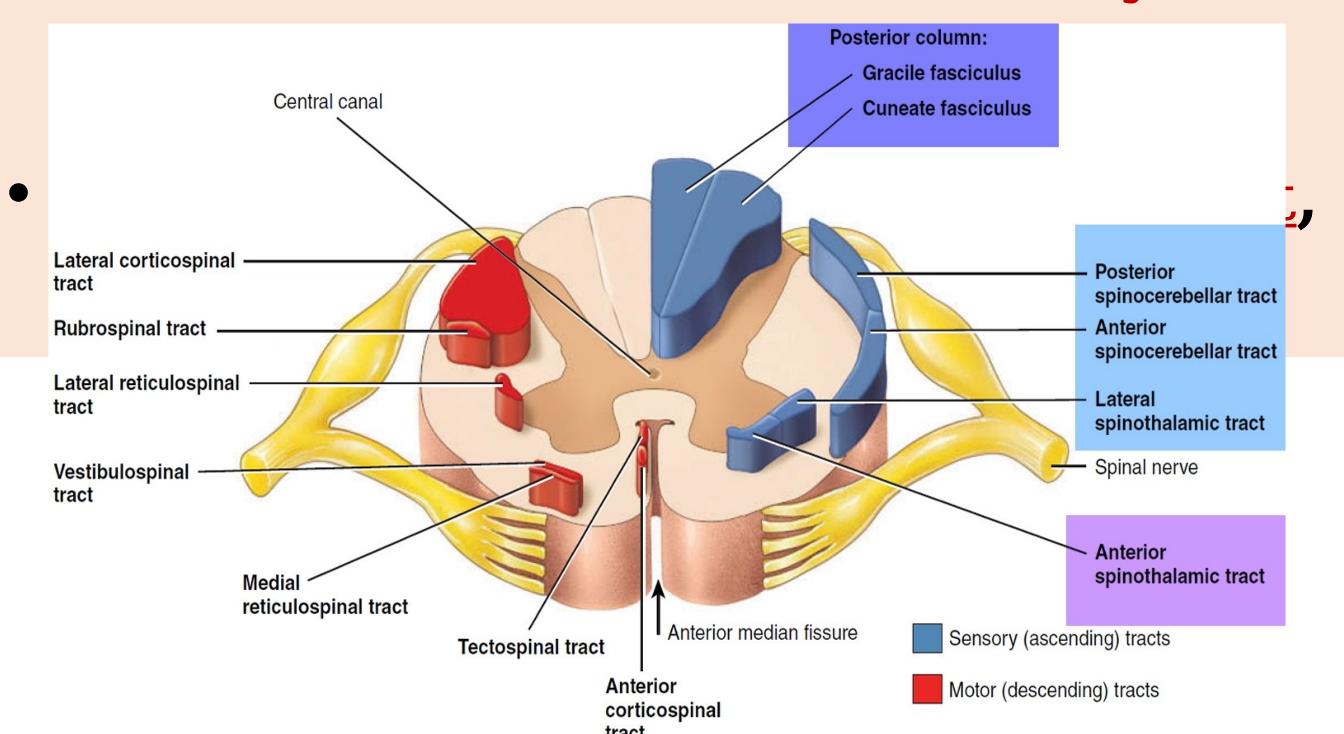
They are formed by the **central processes** of the **pseudounipolar dorsal root ganglion** cells. They enter the spinal cord via the dorsal root.



# Gracile and Cuneate Tracts

## ➢ Position in spinal cord:

- They occupy the **posterior white column**.
- The **Gracile** tract lies **medially** in
- e,




Gracile & Cuneate Nuclei

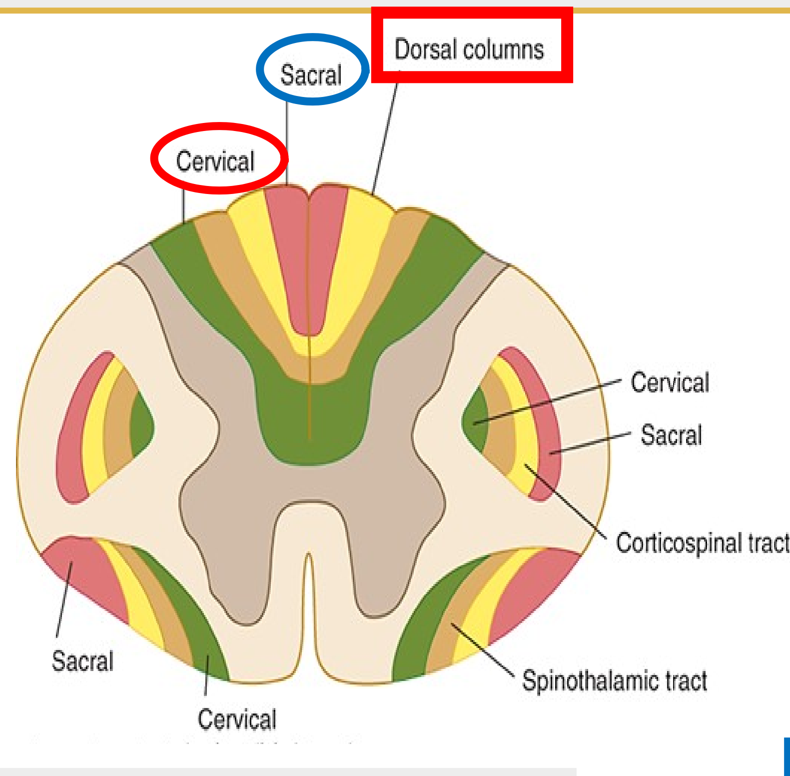
Cuneate

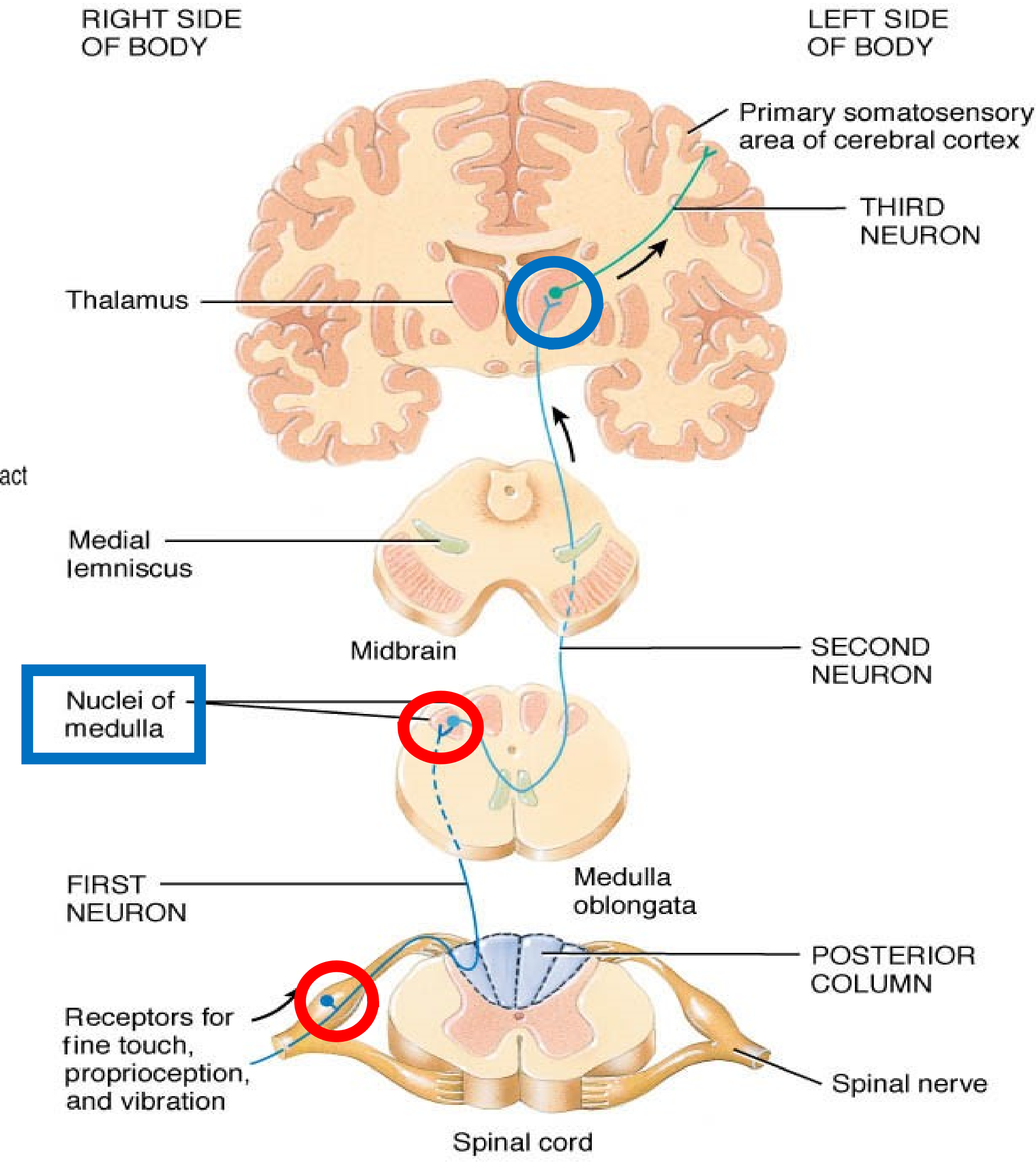
Gracile

# Gracile and Cuneate Tracts

➢ **Lamination:**

**The coccygeal & sacral** fibers lie **most medially** while **cervical** fibers lie **most**




➢ **Termination:**

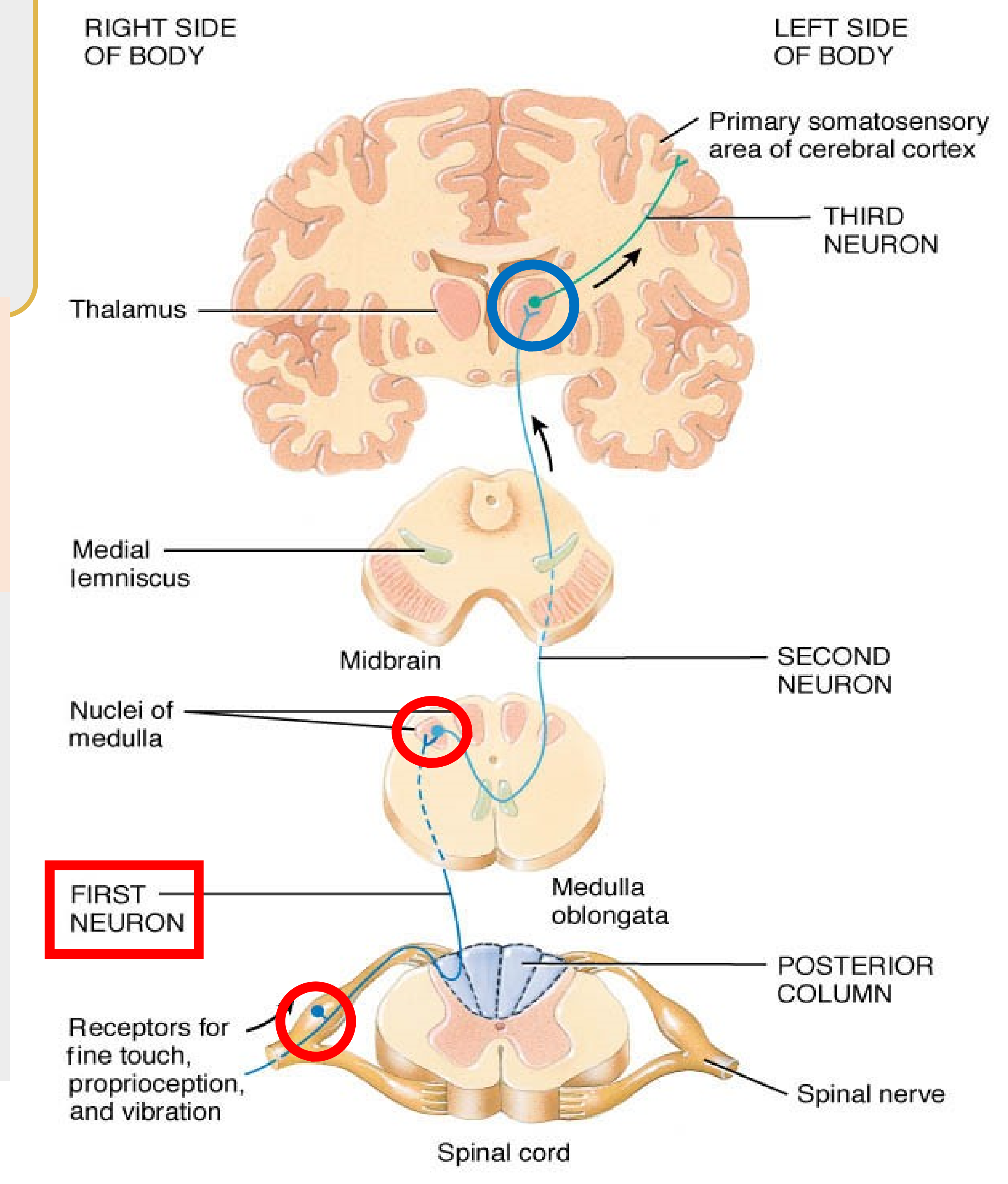
The Gracile & Cuneate tracts ascend in the spinal cord to **reach the medulla** & end on **Gracile &**

# Pathway for Proprioception and Fine Touch

## ➤ First Order Neuron:

**Dorsal Root Ganglion cells (Pseudounipolar)**

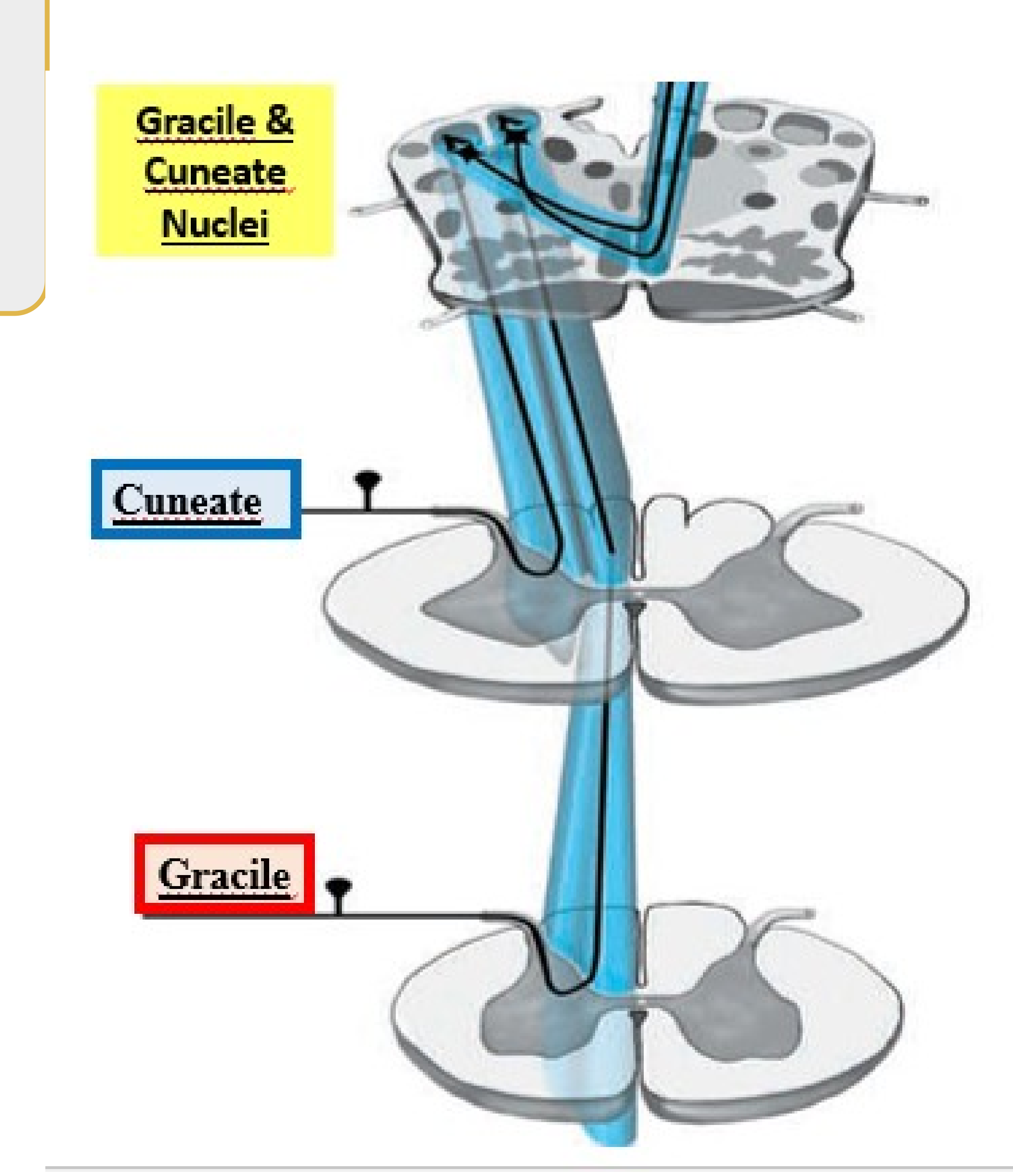
- Their **peripheral processes** carry sensations from **deep receptors (in muscles, tendons & joints).**
- Their **central processes** pass to the spinal cord via the **dorsal root**.



# Pathway for Proprioception and Fine Touch

- Fibers from the **lower part of the body (below T6)** ascend **medially** in the dorsal column forming **the gracile tract.**

- Fibers from the **upper part of the body (above T6)** ascend **laterally** in the dorsal column forming **the cuneate tract.**



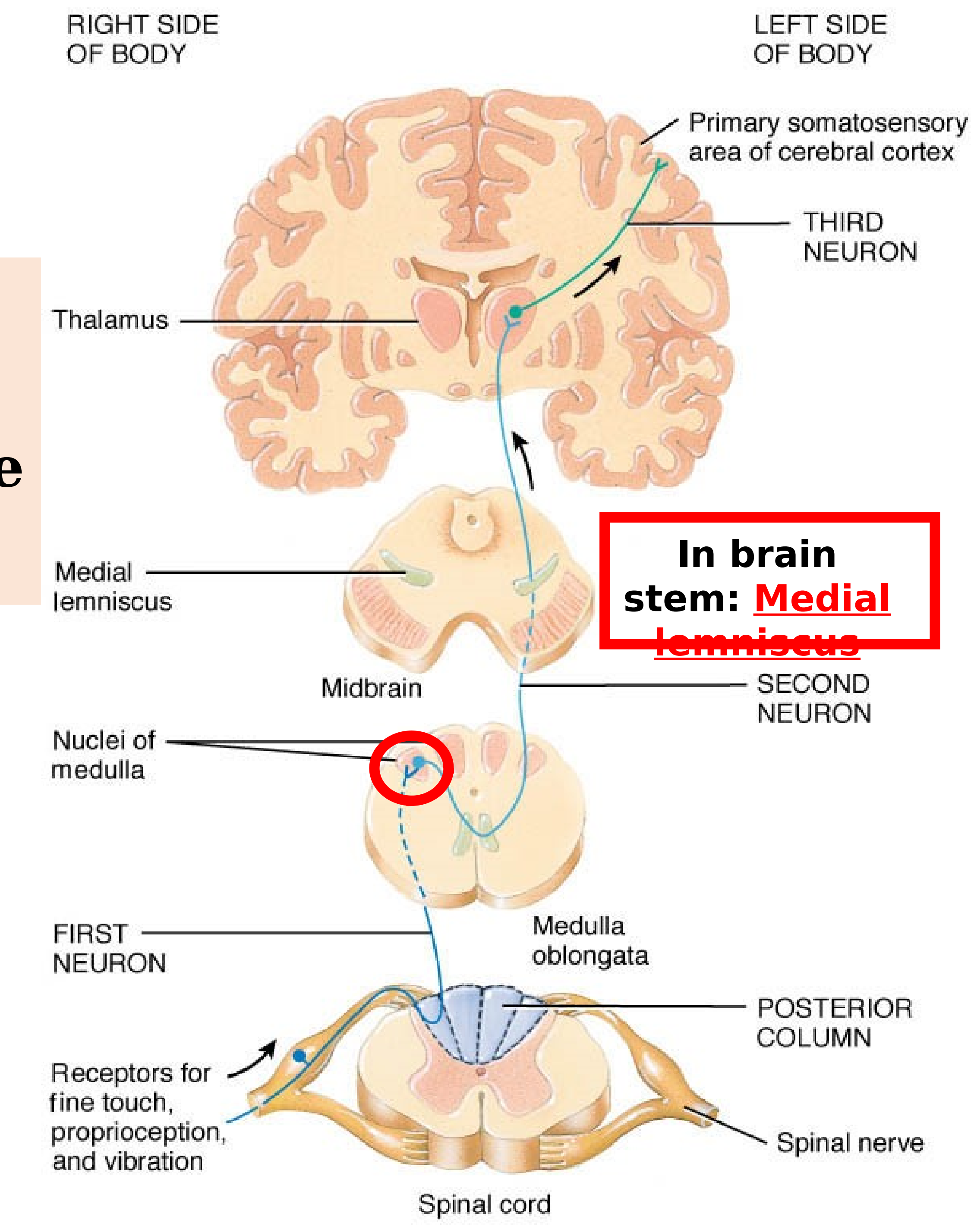
# Pathway for Proprioception and Fine Touch

## ➢ Second Order Neuron:

**Gracile & Cuneate Nuclei of the m**

- Axons of these nuclei **cross the median plane** (forming the **internal arcuate fibers (sensory decussation)**

- Fibers ascend in **brain stem** as **the Medial lemniscus** to reach **the**

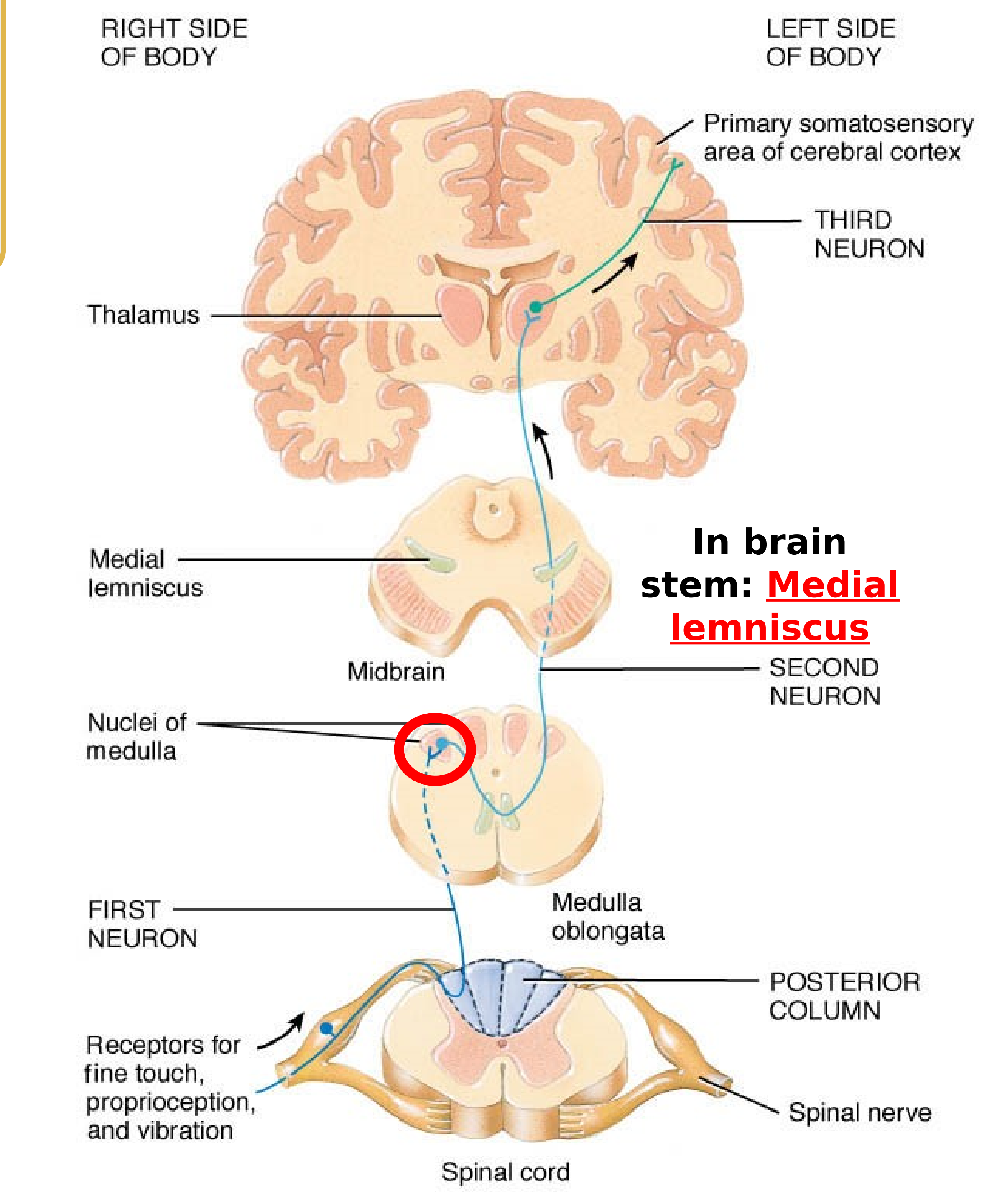


# Pathway for Proprioception and Fine Touch

- **Third Order Neuron:**

**VPLN of Thalamus**

- **Axons of VPLN of thalamus pass in posterior limb of internal capsule then through the corona radiata to reach the sensory area of the cerebral**



## Summary

# The 4 Long Ascending Tracts

## Spinothalamic Tracts

- **Pain & Temp (Lateral S.T.)**
- **Crude touch**

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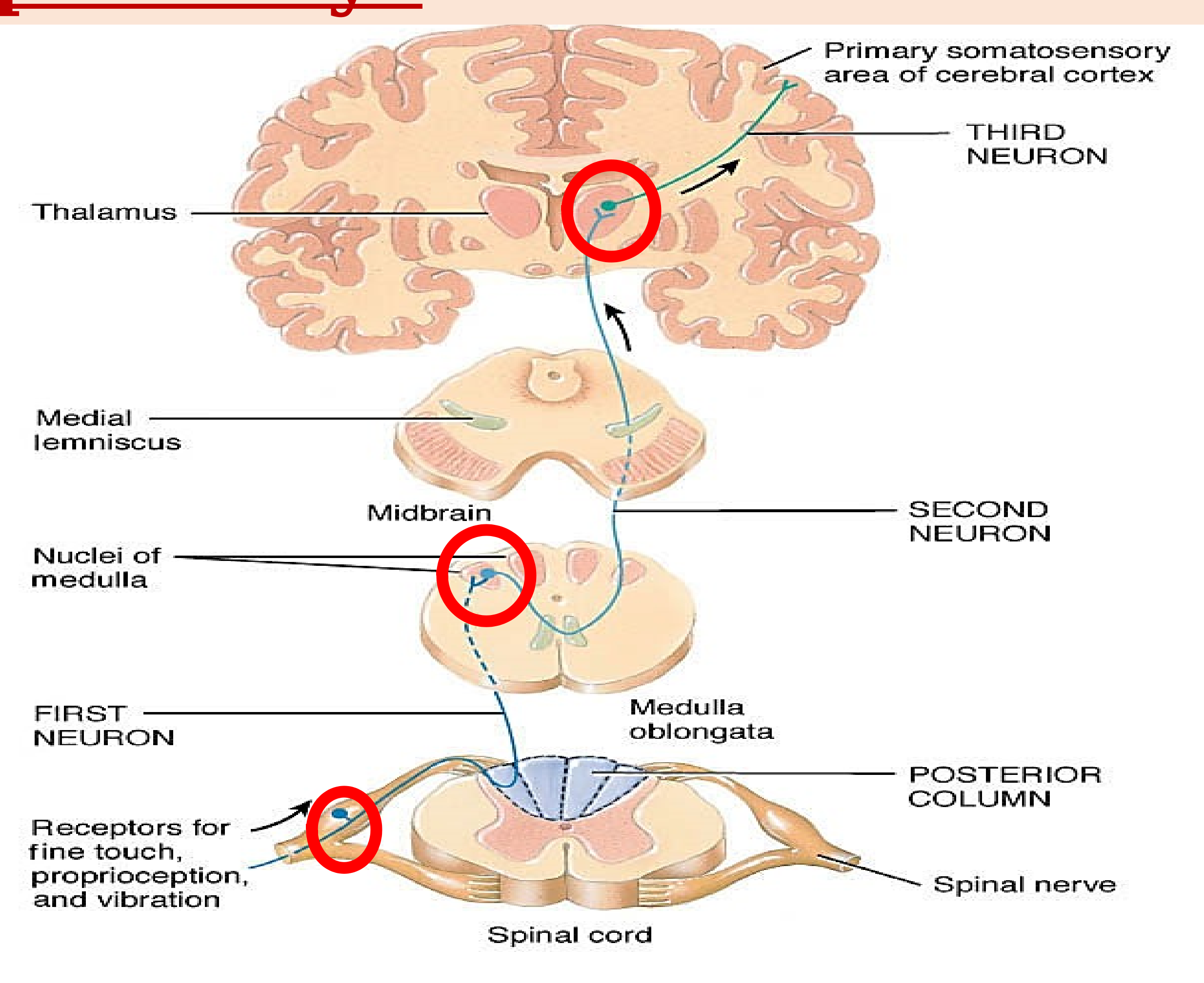
## Gracile and Cuneate Tracts

- **Fine touch**
- **Conscious proprioceptive**

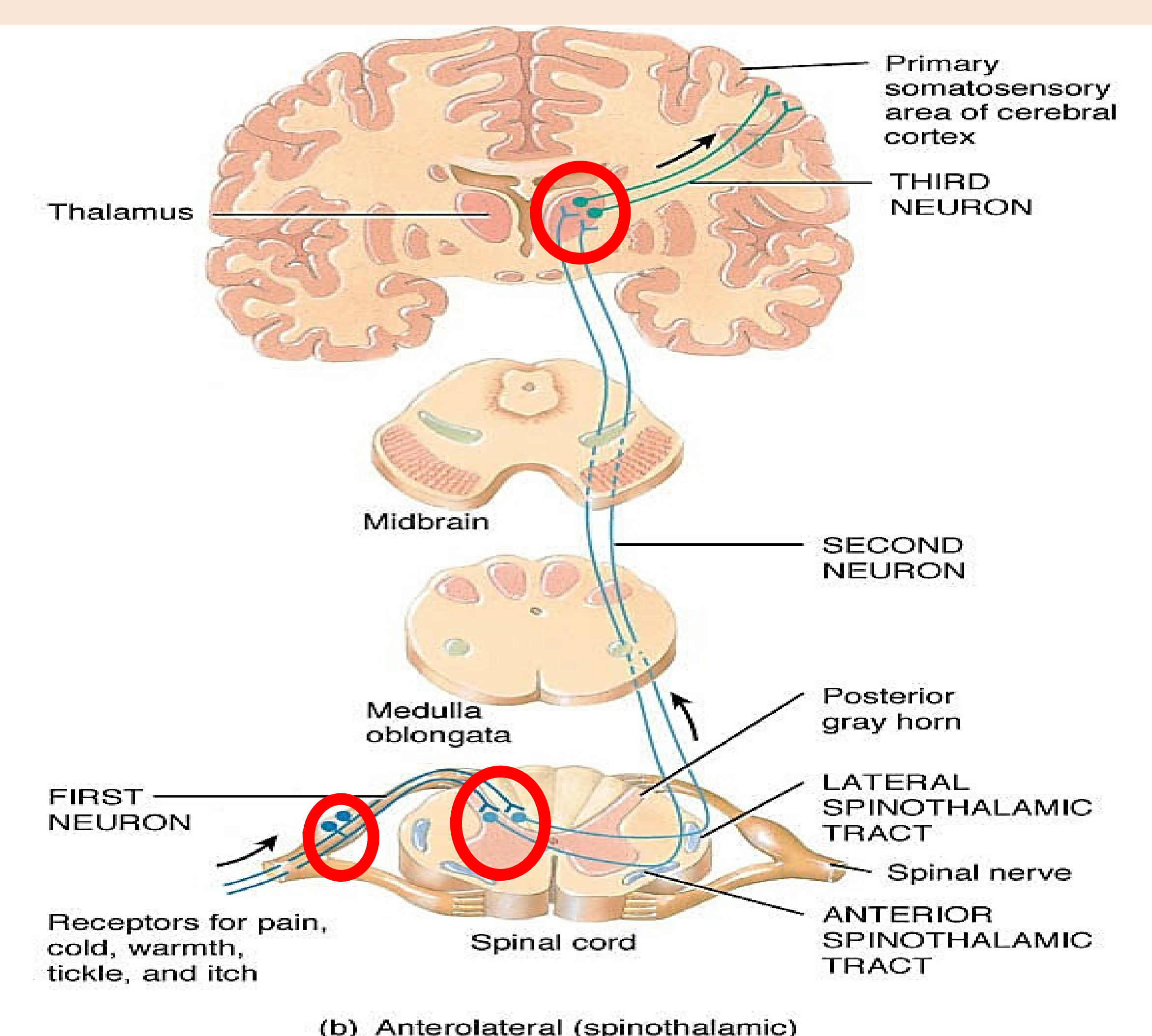
All these ascending sensations from **one side** of the body ascend to □ The **Opposite Side of Cerebral**

# Lecture Quiz

Compare between **Dorsal column** and **Spinothlamic pathways**



(a) Posterior column–medial lemniscus pathway



(b) Anterolateral (spinothalamic) pathways

# Lecture Quiz

**Conscious sense of Sartorius muscle is carried by which of the following tracts?**

**A- Lateral Spinothalamic**

**B- Anterior Spinothalamic**

**C- Gracile**

**D- Cuneate**

**E- Anterior Spinocerebellar**

# SUGGESTED TEXTBOOKS



**Clinical Anatomy for Medical Students .Richard S. Snell**

**Gray’s anatomy for students .**


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# THANK YOU